

AN AEROSPACE SCIENCE COURSE WITH SPECIAL EMPHASIS  
ON VOCATIONAL INFORMATION FOR DEXFIELD COMMUNITY  
HIGH SCHOOL, REDFIELD, IOWA

---

A Field Report  
Presented to  
The Graduate Division  
Drake University

---

In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science in Education

---

by  
Martin L. Pillers  
June 1968

1968  
P6452

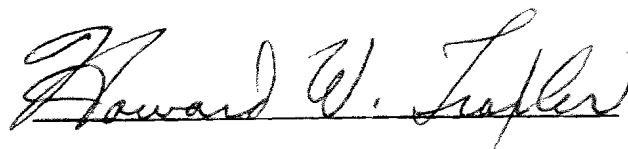
AN AEROSPACE SCIENCE COURSE WITH SPECIAL EMPHASIS  
ON VOCATIONAL INFORMATION FOR DEXFIELD COMMUNITY  
HIGH SCHOOL, REDFIELD, IOWA

by

Martin L. Pillers

Approved by Committee:

  
Chairman



  
Dean of the Graduate Division

## TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION . . . . .	1
The Problem . . . . .	2
Statement of the problem . . . . .	2
Importance of the study . . . . .	2
Definition of Terms Used . . . . .	4
Aerospace education . . . . .	4
Aerospace industries . . . . .	4
Aerospace Industries Association, Inc. . . . .	5
Procedure . . . . .	5
II. HISTORICAL BACKGROUND OF AEROSPACE EDUCATION . .	6
III. REVIEW OF THE LITERATURE . . . . .	10
Guidance in the Space Age . . . . .	10
Curriculum in the Space Age . . . . .	18
Space Age Occupations . . . . .	22
The electronic industry . . . . .	25
The electronic computer industry . . . . .	26
Air transportation industry . . . . .	27
General aviation . . . . .	29
IV. AEROSPACE SCIENCE-COURSE OUTLINE . . . . .	33
(Course outline pages numbered independently, see outline table of contents.)	

CHAPTER	PAGE
V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS . . . .	34
Summary . . . . .	35
Conclusions . . . . .	39
Recommendations . . . . .	42
BIBLIOGRAPHY . . . . .	43



## CHAPTER I

### INTRODUCTION

Historically man's recorded time has been titled according to significant inventions or discoveries of the era, i.e.: Stone Age, Iron Age, Bronze Age, etcetera. October 4, 1957, the world was ushered into the Space Age as the U.S.S.R. launched Sputnik, the first man-made satellite to go into orbit. Man's dream of space travel took a step forward and became feasible reality. But, of more significant importance was the added impetus Sputnik gave to education in the United States. Addition and change of curriculum as well as expansion of pupil personnel services, particularly guidance and counseling, in the secondary schools was very evident after the National Defense Education Act of 1958 came into law.

"Curriculum is not a division of the guidance service, but, the two are closely related because of the similarity of goals and philosophy."<sup>1</sup> It was the growing need for Space Age information and Space Age occupational information in the schools that encouraged the development of a guidance oriented Aerospace Science course.

---

<sup>1</sup>Janet A. Kelley, Guidance and Curriculum (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1955), p. 47.

## I. THE PROBLEM

Statement of the problem. It was the purpose of this study to develop a science course of such scope and content that a curiosity of aerospace sciences would be initiated and would also inform the student of career potentials in the aerospace industries for the Dexfield Community High School, Redfield, Iowa.

Importance of the study. It was learned from a follow-up study of Dexfield Community High School graduates, completed in 1963, that slightly over 40 per cent continued their education in either college or technical school. Of the graduates who attended college around 50 per cent attended Iowa State University with nearly three-fourths of this group enrolled in the Engineering Division. Of the graduates who attended technical schools over 80 per cent were enrolled in electronic training.

Following World War II some of America's technical and engineering know-how was used to develop missile systems and rocketry techniques which were to precede space explorations. Since 1957 the emphasis on aerospace equipment and knowledge is public record. A group of sixty-one industries joined together to form AIA, Aerospace Industries Association, Inc. These industries make up the major contractors and suppliers of equipment and technical knowledge who were

---

to develop the space program in the United States. (It might be well to mention that membership in the AIA is not a criterion for aerospace industry and activity in general. AIA and aerospace industry will be defined later.) "By the end of fiscal year 1966 the AIA members were to represent the largest non-agriculture industry in total payroll and employment."<sup>1</sup> Total employment and payroll of the AIA members was almost equal to that of automobiles and steel combined."<sup>2</sup> "Of the total personnel in AIA firms less than five per cent were classified as non-skilled or those not requiring technical or additional training to hold their jobs."<sup>3</sup>

General comments taken from the returned follow-up questionnaires indicated many graduates hoped the Dexfield curriculum could be expanded to include more elective courses that would depart from traditional offerings, particularly in the science area. The questionnaires also indicated many graduates were in the aerospace industries or the undergraduates were thinking seriously of obtaining employment in aerospace or related industry.

In this study the information from the aforementioned

---

<sup>1</sup>Aerospace Industries Association, Inc., 1966 Aerospace Facts and Figures (Washington, D.C.: 1966).

<sup>2</sup>Ibid.

<sup>3</sup>Ibid.

follow-up study was used to aid the writer in his development of a course of study to fill a need in the Dexfield Community High School's curriculum.

## II. DEFINITION OF TERMS USED

Aerospace education. Aerospace education is "devoted to the development of the knowledge, skills, and attitudes necessary for full appreciation of the significance of aerospace affairs, it seeks to awaken the American public to the challenge of intelligent living in an age characterized by spectacular scientific and rapid cultural change."<sup>1</sup>

Aerospace industries. Categorically there are three basic areas in aerospace industries: (1) manufacturing; (2) air transport; and (3) general aviation. Specifically, manufacturing includes all research, development, fabrication, assembly, sales, major overhaul, maintenance, and modification relating to airplanes and missiles. Air transport includes domestic scheduled airlines, trunk airlines, local service airlines, non-scheduled airlines, and all-cargo airlines. General aviation includes business, commercial, instructional, and personal flying.

---

<sup>1</sup>Aerospace Education (Civil Air Patrol: Ellington AFB, Texas, 1966).

Aerospace Industries Association, Inc. Aerospace Industries Association, Inc. is an association of sixty-one American industries engaged in aerospace manufacturing.

### III. PROCEDURE

The procedure used to complete this study was library research on guidance and curriculum, correspondence and/or personal contact with aerospace industries and AIA members to learn of their personnel needs, and correspondence and/or personal contact with those organizations and individuals interested in and concerned with aerospace education.

## CHAPTER II

### HISTORICAL BACKGROUND OF AEROSPACE EDUCATION

In a sense aerospace education began with the first attempts of man to fly. However, modern aerospace education began, formally, with the organization of the National Aviation Council in 1947 with its headquarters in Washington, D.C. This organization consisted of professional educators and interested lay people. The purpose of this council was to promote aviation education and knowledge in American schools.

America had emerged from World War II as a major world power. Aviation contributed much to building this position. The airplane had proved its worth and value as a war machine and was then looked upon with great expectations for its potential peace time use. The rationale was that young people knew about aviation and airplanes thus teachers should know something about these subjects too. It was also a part of the rationale, ". . . our American education has a definite responsibility in teaching the implication of the air age--in helping students to understand the social significance of the airplane, and to train our youth to meet social, economic, and political complexities of the age in which we live."<sup>1</sup>

---

<sup>1</sup>Program For The Air Age (The Alexis I. duPont Special School District: Wilmington, Delaware, 1949), p. 3.

The National Aviation Education Council evolved into the National Aerospace Education Council in 1962 with the only change in its purpose being the inclusion of space information. At present many states have active Aerospace Education Councils and some states have an Aerospace or Air Age consultant in their state departments of education. Each state's council and purpose is basically the same as the national organization. Their organization generally consists of educators at all levels of instruction, primary school through college, and lay people. Their method of encouraging aerospace information inclusion in the schools may differ from the workshop approach to encouragement of aerospace units in regular teaching.

Air age, or aerospace, education in public schools has grown steadily since the formation of the NAEC in 1947. The A. I. duPont Special School District of Wilmington, Delaware was one of the pioneers in this area. A "Program For The Air Age" was developed and added to the entire curriculum of grades K through 12. The program was inaugurated in 1949 and still remains an integral part of the school's curriculum with periodic up-dating and the inclusion of space topics. Other programs have been established in Hinkley, Colorado, Atlanta, Georgia, Chanute, Kansas, Tucson, Arizona, and many California schools, too numerous to mention. Aviation training is a part of many state universities'

regular course offerings. Purdue University, University of Illinois, Ohio State University, Southern California University, and Central Washington State College are a few of these schools. A bachelor degree program with a major in professional piloting was established at Purdue University. Pilot training in high school became a part of the aerospace activities in Atlanta, Georgia and Chanute, Kansas. Onalaska High School in Wisconsin received a government grant under Title III of Public Law 89-10 to set up an experimental aviation program for the school year 1966-67. This program was to include flight training as well as an orientation to vocations in the aerospace industries.

Many teachers have included aerospace units with their regular subject matter. The Aerospace Education Council of Iowa annually awards the "Willard Coombs Award" to the Iowa classroom teacher who has contributed significantly to furthering aerospace education in the classroom.

Aerospace education workshops are held in over 200 colleges each year to keep teachers informed of developments in aerospace technology and to educate the uninitiated. Aerospace workshops have become commonplace for county teacher institutes and in-service teacher training.

Many AIA members have established education departments for the sole purpose of developing and disseminating aerospace information to schools and interested lay groups.



Cessna and Beech Aircraft Companies and United and T.W.A. Airlines have been especially active in this endeavor. The Sanderson and Jeppeson firms have been very progressive in developing educational media for aviation programs. The Civil Air Patrol has been quite active in both of the aforementioned areas as well as assisting at workshops in colleges and in school programs.

The inclusion and implementation of aerospace and aviation programs in the schools has been a boon. Pertaining to this statement Saden has said, ". . . the schools who have aerospace courses do not have difficulty in challenging students."<sup>1</sup>

---

<sup>1</sup>Samuel J. Saden, "Curricularizing Space Age Education," Education (February, 1965), 35.

## CHAPTER III

### REVIEW OF THE LITERATURE

In this chapter, the literature in the areas of guidance, curriculum, and occupations in the Space Age have been reviewed in order that the writer might better point out the need for a guidance oriented aerospace science course.

#### I. GUIDANCE IN THE SPACE AGE

Although guidance was not new to education the guidance service did receive a welcome boost from Sputnik when it was launched in October, 1957. The National Defense Education Act of 1958 included provisions to expand existing services and much of the cost, including large portions of the salaries of counselors, would be borne by the government. Schools which felt themselves too small to avail themselves of the guidance services now found it was to their advantage, financially and educationally, to establish guidance facilities and services within their programs. Once established the problem became the scope and extent of utilization of guidance services in the school.

To utilize guidance principles and techniques of the 20's and 30's in the Space Age would have been as much a disservice to the school population and community as it

would have been to not include any knowledge since 1945 in the curriculum. The world was moving faster, thanks to the Space Age, and school children were staying in step. The children of the Space Age may not be any smarter than their parents or grandparents but they knew about more things--mainly due to communication sophistication and development.

Guidance services were coming of age in the Space Age and the services were sorely needed as the bulk of educational information was increased to the point that only an interested trained specialist could expect to keep up with new and changing developments.

The great clamor for guidance services was born more from public demand than from within the educational community. Manpower reports of the 50's and early 60's such as:

A Policy for Skilled Manpower, by the National Manpower Council.

The President's Report on Education Beyond the High School

The National Defense Act of 1958.

The Conant Report on the American High School Today.

The White House Conference of Children and Youth in 1960.

The Manpower Development and Training Act.

The President's Report on the Status of Women.

The Portrait of the Unemployed.

The One-third of a Nation, The Report on Draft Rejectees.

The Vocational Educational Act of 1963.<sup>1</sup>

---

<sup>1</sup>"The Dimensions of Guidance Services In The Space Age," Educational Guidance in the Space Age, National Aeronautics and Space Administration in Cooperation with the U.S. Office of Education Dept. of Health, Education, and Welfare (Washington, D.C.: Government Printing Office, 1964), p. 40.

The calls for these reports came at the national level and included lay people as well as professional educators. "The reports did much to bring the cause and need for guidance services to the public and it is from the public any educational program receives its support."<sup>1</sup>

The guidance program itself had to be ever mindful of the individual and use all tools at hand to aid in his development. "In aerospace industries the term 'spin-off' is used-information compiled, useful, but seldom if ever used."<sup>2</sup> In guidance we all too often have "spin-off" as information is compiled, neatly filed, and forgotten, its significance for individualization and improvement of an individual overlooked. "Often too, we are somewhat hesitant, or slow, to adopt new practices that have proven successful in other schools."<sup>3</sup> "Perhaps another aerospace industry term could be used here--the 'N.I.H.' factor--not useful because not-invented-here."<sup>4</sup> The "N.I.H." factor deters adoption of programs which might facilitate innovation in education and guidance. Guidance, to be effective in the Space Age, will have to do away with "spin-off" and "N.I.H." and, ". . . will need to consider several dimensions."<sup>5</sup>

---

<sup>1</sup>Ibid.

<sup>2</sup>Ibid., p. 44.

<sup>3</sup>Ibid.

<sup>4</sup>Ibid.

<sup>5</sup>Ibid., p. 39.

Seldom today will youth see their parents at work.

"A dimension of the guidance service is to realize that youth do not have the same concepts of work or occupations that were had 10 or 15 years ago."<sup>1</sup> And for good reasons. There are thousands of new kinds and types of occupations open to them now that were not heard of a few years ago. The guidance service must move out actively to bring an awareness of this shifting world of work to young people. This may necessitate the counselor becoming involved in more outside-the-school activities such as hobby and career clubs, youth groups, etc.

The guidance service cannot overlook the importance of hobbies and career clubs. The emphasis on pure science and mathematics in the late 50's and early 60's led to a strong academic emphasis on the theoretical side of these subjects but not too much on the practical application of the theory.

The Martin Corporation of Baltimore, Maryland noted a characteristic of their engineering people hired in middle 60's--a characteristic in which longer times were needed for on-the-job orientation and proficiency in comparison to engineers hired in the 50's and early 60's. It was a slowness to apply theory to practical application as little, if any, experience in practical application had been obtained. The study revealed the earlier groups of engineers had been model airplane and boat builders, "Ham" radio operators, or auto and machinery tinkers. They had managed to build or

---

<sup>1</sup>Ibid., p. 41.

maintain their hobbies without expensive, sophisticated, and elaborate equipment. Problems in their engineering work were often solved thanks to this background of practical knowledge. The newer engineers, while striving for academic excellence had not had, or taken, time for a hobby and thus were at a disadvantage for periods up to two years when they went on the job.<sup>1</sup>

The space program of the Space Age is practical and is a part of the real world; thus hobbies and career clubs that may be allied with a vocational choice should be encouraged and not downgraded.

Another dimension the guidance service must consider is that even in the technical Space Age we are still dealing with people. "If the schooling and counseling is confined to technical knowledge the individual may be ill prepared to deal with people."<sup>2</sup> The social sciences should not be overlooked. "Also, if technical knowledge and specialities are overemphasized in the classroom we may create a generation of cybertrons."<sup>3</sup> (Cybertron from cybernetics--comparative study of automatic control systems of the nerves, brain, and corresponding electronic and mechano-electrical systems and devices.) When working with cybernetics, Ashby<sup>4</sup> worked out a self-adjusting device called a homeostat. He compared the function of the homeostat in cybernetics to the

---

<sup>1</sup>Ibid., p. 28.      <sup>2</sup>Ibid., p. 41.      <sup>3</sup>Ibid., p. 42.

<sup>4</sup>W. Ross Ashby, Design For A Brain (New York: John Wiley and Sons, Inc., 1960), p. 53, p. 100.

human capability of accomodation of a stimulus and coming to equilibrium even though the entire stimulus might not be understood. The unaccomodated portion would be "filed" in the memory banks of the brain for later use. Some homeostats were so designed that they would never find equilibrium. McDaniels drew the analogy between classroom overcontrol and non self-adjusting homeostats. He said, ". . . if we get individuals so attuned in technical knowledge and speciality by overcontrolling them in the classroom that they will try to attain equilibrium at any cost, without accommodation, we may create a homeostatic society incapable of self-adjustment."<sup>1</sup> The implication of this to civilization was quite important. "Our civilization has survived because a balance can be quickly obtained and without frustration if the individual is incapable of accommodating an entire stimulus."<sup>2</sup> "Perhaps it would be best to allow students to experience some failures, to come to equilibrium by themselves rather than be forced into it, and continue to be a self-adjusting society."<sup>3</sup> Saden commented,

. . . that the implantation of proper attitudes, appreciation of ideals for the object ideology in the lessons of the subject matter taught were of prime interest to education during the "Wheel Age."<sup>4</sup>

---

<sup>1</sup>NASA, op. cit., p. 42.

<sup>2</sup>Ibid.

<sup>3</sup>Ibid.

<sup>4</sup>Samuel J. Saden, "New Horizons For Space Age Youth," School Science and Mathematics (June, 1965), 493.

"In the Space Age the emphasis is on aptitudes as it gives the individual distinguishing capabilities."<sup>1</sup> In the Space Age a combination of aptitudes may be needed to adapt to society and enable an individual to realize life goals.

Guidance in the Space Age must be aware of the rapid change and growth of technology in American industry, particularly in those highly scientific occupations associated with the aerospace industries. "The number of technicians increased 643 per cent from 1940 to 1960 and from 1960 to 1964 the increase was 144 per cent and the need was still considered critical."<sup>2</sup> This was to reflect a greater increase than any other occupation group. "This growing need for professionally trained workers with a relatively stable percentage of potential applicants raises another dimension to consider."<sup>3</sup> "Can a counselor permit freedom of choice among his counselees when glowing discrepancies in our labor force exists and the talent and the aptitudes are evident."<sup>4</sup> This dimension may infringe on the counselor's counseling frame of reference. But,

. . . it has been suggested that exploratory work experience programs and increased activity in group and individual counseling programs with parents and students to promote understanding and realistic educational and career planning may aid the counselor

---

<sup>1</sup> Ibid.

<sup>2</sup> NASA, op. cit., p. 42.

<sup>3</sup> Ibid.

<sup>4</sup> NASA, op. cit., p. 43.



in maintaining a consistent frame of reference and at the same time implement the guidance program to provide as much information and activity for the counselee to use in making his decision.<sup>1</sup>

Another factor in the guidance planning of, and for, an individual was that new knowledge, new developments, and changing conditions often called for changing plans. Pluimer, in his many talks to educators and lay groups, was to point out the magnitude of amassed knowledge. "Knowledge has doubled several times since man's first records of recorded time and history, the most recent doubling was in the past 15 years and the next doubling will occur by 1975."<sup>2</sup> It was very easy to see why the individual must be able to adjust and accommodate readily to new information. "The ability to adjust and accommodate is enhanced greatly by a good fundamental education and a continuing desire to learn."<sup>3</sup>

A final dimension in Space Age guidance was a reconfirmation of the principle that teachers must be involved in the guidance program. "The guidance environment works best when the pupil grows in self-understanding, makes plans, and progresses toward well chosen goals."<sup>4</sup> This was true in the classroom as well as in the counselor's office.

---

<sup>1</sup>Ibid.

<sup>2</sup>Harold Pluimer, "Frontiers of Education In The Space Age" (Dallas County Teacher's Institute: Adel, Iowa, Sept., 1947).

<sup>3</sup>NASA, op. cit. p. 44.

<sup>4</sup>Ibid.

Space Age dimensions of guidance were not really new dimensions but modification of old to meet changing times. The guidance program was basically committed to aiding the individual and quality education. Quality education may involve individualized education and improvement of instruction and curriculum which was to provide for a more complete development and uniqueness of each individual.

## II. CURRICULUM IN THE SPACE AGE

The Space Age pointed up the need for schools to look at their course offerings and consider the needs of the students in contemporary society and projected society rather than in the light of traditionalism. Kelley stated, ". . . that courses of study had remained traditional more for the welfare and security of the parents than for any logical educational reason."<sup>1</sup> "Conant and Rickover made inferences on school traditionalism in their comments of the late 50's which resulted in schools adopting changes that have shown profound improvement to sustain better holding power and extent of offerings to challenge those of various capacities and interests."<sup>2</sup> (In the preceding commentary the word curriculum was purposely omitted. Oliver

---

<sup>1</sup>Kelley, op. cit., p. 38.

<sup>2</sup>Saden, op. cit., p. 492.

infers curriculum does not have a definition as curriculum can only have meaning when used in proper context with a school, a department, or an individual because curriculum is individualized for areas such as a school, a department, or an individual.)<sup>1</sup>

"In a sense curriculum has always existed, even without schools, the problem was not to create it but to keep it current."<sup>2</sup> This was true in the past and much more applicable now, ". . . as startling expansion of knowledge causes curriculum obsolescence at a rapid rate."<sup>3</sup> "This currency requirement in educational offerings is one which the counselor must give his attention as well as teachers, administrators, and communities."<sup>4</sup> Keeping course offerings and curriculum up to date is first of all a problem of being informed of current developments and secondly knowing what needs to be done so changes can be accomplished at the time needed and not in wholesale lots after great time intervals. In a world-society that is rapidly changing this was no small task. Dulles stated, ". . . that probably in the late years of this century, we would have more change in a 5-year period than any other period in history."<sup>5</sup> Who, then but the

---

<sup>1</sup>Oliver, op. cit., p. 2.

<sup>2</sup>Ibid., p. 1      <sup>3</sup>Ibid.

<sup>4</sup>NASA, op. cit., p. 6.

<sup>5</sup>Ibid.

schools should be better prepared to educate and inform a young person so as to be able to adapt to an adult society with rapidly changing technologies?

A point not to be overlooked when considering curriculum change and/or modification was brought out by Hahn:

We no longer have a time lag between acquisition of new knowledge--the discovery of scientific principles for example--and its application. There was 50 years between the discovery of the electromagnetic induction principle and the invention of the generator. Sufficient time to school and train technicians. There was 30 years between the discovery of electron emission in a vacuum to the growth of the electronic industry and 10 years from the discovery of the neutron to nuclear reactors. There was less than three years between the discovery of semiconducting properties and transistors. Time lag for educational purposes no longer exists.<sup>1</sup>

The Civil Air Patrol related seven modern curriculum trends to Space Age education as a rationale for Aerospace Education. They were:

1. To recognize interest, purpose, and experience as factors in child growth and development. Through aerospace education, spontaneous pupil interest in aircraft, rockets, missiles, and space vehicles may be used to lead pupils into many different exploratory enterprises.
2. To provide students with guided experiences which will help them understand the complex age in which they live and to assume responsibility for the improvement of life's conditions. A curriculum responsible to the challenges of present-day living must seek to develop understandings of life in the Aerospace Age so that students acquire the knowledge, skills, and attitudes necessary for effective, democratic citizenship. The inclusion

---

<sup>1</sup>NASA, op. cit., p. 24.

- of aerospace education in the curriculum offers a unique opportunity to accomplish this.
3. To realize the school's responsibility to provide career guidance and education for vocational competence. The aerospace industries, governmental agencies, air transport industries, military services, general aviation, and industries expanding because of aerospace developments require the services of several million trained people. One of the specific objectives of aerospace education is to stimulate awareness of available aerospace careers and to develop talents and skills for success in those careers.
  4. An integrated curriculum, organized around a major interest employed as a frame of reference. Through the enrichment approach standard course offerings are supplemented with pertinent aspects of the aerospace sciences which are major factors of many general study units, such as "Living and Working Together"; "Communicating Ideas"; "Discovering Our World of Science"; "Transporting Goods and Services"; and "Exploring the Universe."
  5. The use of community resources as aids to learning. Aerospace education provides an opportunity to supplement classroom instruction with popular, educational experiences such as trips to local airports, air bases, aerospace manufacturing firms, etc. In addition, local, state, and national aviation agencies, aerospace industries, and other interested organizations provide major aerospace education resources.
  6. The acceptance of in-service teacher education as a permanent and integral aspect of curriculum improvement. A study of the effects of aerospace progress upon modern life must not be neglected by teachers who desire to do a competent job of guiding today's pupils or students. A good way to complete such a study is by participation in aerospace education projects either during summer vacation or after class hours during the school year.
  7. Extend the services of organized education to the adults of the community. Aviation and astronautics are attractive and important areas of adult education. Expanding career opportunities in the aerospace industries stimulate many adults to seek training in technical aerospace vocations; the broad effects of aerospace progress stimulates others to study about the influences of aviation

and astronautics. Air travel courses and courses in aviation for farmers are common among adult offerings.<sup>1</sup>

Oliver touched on some of these points; new knowledge, community needs, and changing society not only as a rationale for change but also to serve as responsible parties in aiding and effecting change.<sup>2</sup> Oliver also felt that curriculum improvement was a cooperative effort and received the best support when changes were effected this way.<sup>3</sup>

The Aerospace Science course for Dexfield Community High School was developed through the cooperative plan, cognizant of the modern trends in curriculum, and to serve a need in the school and community.

### III. SPACE AGE OCCUPATIONS

The high level of enthusiasm by American youth in the many aerospace related fields of interest is matched by the growing need for well educated and trained personnel to sustain and carry forward the aerospace programs now under development. The career opportunities are almost limitless now that all of the immediate and potential needs of space exploration have been added to those of aviation to form the social, scientific and technological complex of aerospace.<sup>4</sup>

---

<sup>1</sup>Civil Air Patrol, loc. cit.

<sup>2</sup>Oliver, op. cit., pp. 32-35.

<sup>3</sup>Ibid., p. 219.

<sup>4</sup>Richard Harbeck and Bettina Weary, "Selected Aerospace Career and Scholarship Information," Selected Science Services (Washington, D.C.: U.S. Dept. H. E. & W., Govt. Printing Office, 1962).

America's entry into the Space Age caused rapid growth in the aircraft, missile, and spacecraft field. The rate of growth was to slow in the later 60's--due primarily to the cut-back of federal spending in support of the space program--however, activity in the other areas of the aerospace industries was to remain strong and total employment and payroll of the aerospace industries still larger than any other non-agriculture group. The nature and activity of the aerospace industries created a disproportionate demand for technicians.

Because this industry's products are complex and changing, the majority of job openings will be for workers having a college education or a specialized skill. Scientists, engineers, and technicians represent a much larger proportion of total employment in the aerospace industry than in most manufacturing industries, and will probably account for an even higher proportion during the 1965 to 1975 decade. In addition to professional and technical workers, increases are also expected in the employment of skilled workers, such as tool and die makers, skilled assemblers and inspectors, welders, and various types of mechanics. Employment of semi skilled and unskilled workers, on the other hand, is not expected to grow and may even decline.<sup>1</sup>

Large corporate industry was considered the backbone of aerospace production but, "many thousands of subcontractors participate in the production of parts and subassemblies

---

<sup>1</sup>Bureau of Labor Statistics United States Department of Labor, Occupational Outlook Handbook (Washington: Govt. Printing Office, 1966-67), p. 572.

that go into aircraft, missiles, and spacecraft."<sup>1</sup>

Occupational needs vary among the aerospace industries depending on the work being done.

Some of the more important jobs in aerospace manufacturing are listed under three major categories; professional and technical occupations; administrative, clerical, and related occupations; and plant occupations.<sup>2</sup>

General descriptions of jobs in the areas are:

Professional and Technical Occupations--research, design, experimentation, and testing. Primarily college graduates with engineering degrees.

Administrative, Clerical, and Related Occupations--Comparable to managerial and administrative positions in other industries, except they are generally more closely related and oriented to engineering because of research and development in the aerospace field. Primarily college graduates and/or business school graduates.

Plant Occupations--Classified in the following groups: sheet metal work; machining and tool fabrication; other metal processing; assembly and installation; inspecting and testing; pre-flight checkout; and materials handling, maintenance, and custodial. With the exception of the last mentioned jobs this group requires technical school and/or on-the-job experience to become a skilled worker. This group constitutes about one-half of all workers in the aerospace industries.<sup>3</sup>

Employment in the aerospace industry was expected to maintain its position among American industries and show little significant change during the 1965 to 1975 decade.

---

<sup>1</sup>Bureau of Labor Statistics, op. cit., p. 573.

<sup>2</sup>Ibid., p. 574.

<sup>3</sup>Ibid., pp. 574-578.



"There would still be tens of thousands of job opportunities annually in this large field."<sup>1</sup> In addition, it was estimated 20,000 to 30,000 job openings would be available due to retirements and deaths during 1965-1975."<sup>2</sup>

Products from the aerospace industries were developed, primarily, to assure national security and to advance America's goals in the conquest of space. But, the knowledge and techniques learned in developing security and space products have had a beneficial "spin-off" as much of this information and technique was readily adaptable to, and for, civilian consumer goods.

Among the aerospace industries whose knowledge, technique, and services were most readily available to, and for, the civilian consumer were the: Electronic; Data Processing; Air Transport; and General Aviation industries. Collectively these industries employ more than one-half of all the employees in the aerospace industries. Individually, each of these industry's growth patterns was rapid in the past two decades and projected figures indicate that change and growth will continue to be significant however, not as rapid.

The electronic industry. Prior to World War II this

---

<sup>1</sup>Bureau of Labor Statistics, op. cit., p. 579.

<sup>2</sup>Ibid.

industry was engaged mainly in producing radio transmitters and receivers. Their image has changed considerably.

Following World War II the discovery of semiconductors and other devices that control or direct the flow of electrons led to many unique and sophisticated devices which was to have many applications. The entrance of electronics into navigation and production control (computers) was to create a greater demand for these products as well as increased use of electronic components in consumer goods for the home.

Introduction of semiconductors, solid state, and miniaturization into electronics was to create a need for increased training and skill for those persons involved in testing and maintaining the complex machinery and equipment.

Employment forecasts in the Electronic industry for the next decade is expected to show increases for administration, engineering, and technical personnel and relatively stable demands for semi skilled and non skilled positions. There is also expected an increase for the need of mathematicians as electronic manufacturing becomes more involved with computer design and construction.<sup>1</sup>

#### The electronic computer industry (Data Processing).

An offshoot of the electronic industry was the electronic computer industry which was sometimes called "A Young Giant."<sup>2</sup>

Barely 20 years old, this new industry has grown rapidly. The first general purpose computer designed for business data processing and scientific use went into operation in 1948. By 1966 it was estimated 4,500 computers were in use; by the close of 1966, a meteoric rise to more than 38,000 had occurred and 22,000 more machines were reported to be on order. It is expected that computers in use in business, industry, and science would increase to 85,000 by 1975.

Manpower requirements are unusual inasmuch as so

---

<sup>1</sup>Bureau of Labor Statistics, op. cit., p. 655.

<sup>2</sup>Bureau of Labor Statistics United States Dept. of Labor, Occupational Outlook Quarterly (Washington, D.C.: Govt. Printing Office, XI, December, 1967), 18-19.

much powerful equipment can be assembled by a relatively small work force but, the increase in the machines needed would reflect a substantial increase in the work force. The distribution of occupations are equally divided among white-collar and blue-collar which is a unique situation.

General education requirements for both classifications are also higher than usual as more than a high school education is needed for most jobs. Approximately one-fourth of the workers in computer manufacturing are involved in research and design which required extensive education and training. The post-high school training for technicians is generally two years with periodic up-dating on the job to keep abreast of new developments.

Although technological improvement continued to increase the output per worker, the growing demand for computers will cause expanding employment in the Electronic Computer Industry.<sup>1</sup>

Air transportation industry. The success and growth of the air transportation industry was best shown by the continuing increase of passengers carried and the decrease in cost per passenger mile during the period 1956-1966 and continuation of these trends forecasted for 1966-1976.<sup>2</sup>

"Passenger miles during the decade 1965 to 1975 are expected to double."<sup>3</sup> The introduction of high density seating, high speed jet airliners was to cut travel time tremendously and make it possible for business men to make,

---

<sup>1</sup>Bureau of Labor Statistics, loc. cit.

<sup>2</sup>Air Transportation Association of America, 1967 Air Transportation Facts and Figures (Annual Report, Washington, D.C.: Jan., 1967), 26-27.

<sup>3</sup>Ibid., p. 2.

and keep, widespread appointments in the same week or even the same day. "Family travel plans"<sup>1</sup> to vacation sites were to encourage the general public to utilize air travel and make more time available for recreation and leisure during vacations or visits.

The growth of trunk air lines (major coast-to-coast and border-to-border lines) precipitated growth of local-service airlines and connecting airlines. Local-service lines provide air transportation service to population centers not served by trunk lines and connect with the trunk lines at major points within the geographical boundaries of their operational scope. Ozark Airlines servicing towns such as Iowa City, Ottumwa, Cedar Rapids, and connecting with trunk lines in Des Moines is an example of a local-service line. Ozark also services several states surrounding Iowa. Connecting airlines serve less populated areas, generally areas with one or more small industries, and connect to cities served by local or trunk lines. Commuter Airlines of Sioux City, Iowa, is an example of a connecting line serving Iowa.

Boltz, in his comments before a Senate Committee, stated the following projections for air transport growth:

1. The U. S. Civil air carrier fleet is expected to grow from 2,200 aircraft in 1965 to about 3,200

---

<sup>1</sup>Ibid.

aircraft in 1980. The airlines now have on order about 90 stretched jets, about 100 high-capacity 747's, some 185 SST's, and more than 800 other jets. These represent investments of some \$12 billion--and this probably is just the beginning.

2. Revenue passenger-miles of operation have been projected from 65 billion passenger-miles in 1965 to 315 billion passenger-miles in 1980.
3. The revenue ton-miles of operation are expected to grow from approximately 3 billion ton-miles in 1965 to about 38 billion ton-miles in 1980. This includes only cargo carried by cargo aircraft.
4. In 1965 there were 22,972 air carrier pilots; the projected need is for 43,665 by the end of 1980. Traditionally, the applicant to acceptance ratio for pilots has been 10 to 1, or greater, in the air carrier industry. Thus approximately 430,000 pilots with the present-normal training will be needed if the traditional ratio remains constant or, the quality of our present pilot training programs must be improved to meet future needs.
5. The air carrier industry employed 43,667 mechanics in 1965; by the end of 1980 80,224 will be needed.
6. The need is a current one, as well as one projected in the future. The Air Transportation Association has estimated 4,300 new pilots and 6,800 new mechanics will be hired during 1967.
7. Total airline payrolls increased from \$1.7 billion in 1965 to \$1.9 billion in 1966. The average airline salary was \$7,910 in 1966.<sup>1</sup>

General aviation. Following World War II the expected boom in general aviation occurred but was short-lived. It was hoped that airmen trained in the service would continue flying and the "G.I. Bill" provision to pay for flight training

---

<sup>1</sup>United States Congress, Senate, Committee on Govt. Operations, Statement made by Ide K. Boltz, President, National Aerospace Education Council, hearing before Committee, 90th Congress, 1st. Session, on S. 1602, October 27, 1967 (Washington, D.C.: Govt. Printing Office, 1967), pp. 4-5.

would encourage other service discharges to take to flying for either business or pleasure. In 1947 there were over 1,500 flight schools in the United States; by 1950 there were less than half that number. Light plane manufacturers realized, almost too late, that the demand for light airplanes would be met by the availability of low-cost government surplus airplanes. Numerous ventures into light plane manufacturing were unable to stay in business due to poor financial situations. Only the "Big Three," Beech, Cessna, and Piper, managed to stay in business with any success during the later 40's and early 50's. In the middle 50's a combination of the development of relatively inexpensive VHF radio equipment, federally operated VHF radio navigational aids, increased airport improvements and construction, light aircraft becoming faster with more personal comfort, and greater general public acceptance of civil aviation was greatly responsible for an increase in instruction and light plane manufacture. The development of general aviation was covered in several points of a report to the late President, John F. Kennedy, on the National Aviation Goals,<sup>1</sup> completed in 1961 and preceded by a forecast for general aviation

---

<sup>1</sup>Fred M. Glass, Chmn., "Summary of National Aviation Goals," A study ordered by President John F. Kennedy defining aviation goals that applied to the period 1960 through 1970. (Washington, D.C.: U. S. Govt. Printing Office, September, 1961).

completed in 1955, the Curtis Commission Report.<sup>1</sup> This later report proved to be conservative as predictions for the late 60's and early 70's were surpassed during the mid 60's.<sup>2</sup> Recent forecasts and employment needs for general aviation, as stated by Boltz, are:

1. Approximately one-half of all civil aviation mechanics and more than one-half of all pilots with professional skills are engaged in general aviation activities. General aviation includes all civil aviation except air carriers.
2. At the end of 1965 there were 95,442 general aviation aircraft in the United States; it is estimated that this total will grow to 315,000 at the end of 1980.
3. General aviation aircraft flew a total of 16.7 million hours in 1965; the forecast is a total of 63 million flight hours in 1980.
4. General aviation employed approximately 48,760 commercial pilots in 1965; it is estimated that 182,000 pilots with commercial licenses will be required by the end of 1980. These figures do not include any requirement for pilots flying personal aircraft.
5. General aviation mechanic employment has been estimated at 40,000 in 1965; approximately 138,000 aviation mechanics will be needed by 1980.
6. Considerable avocational interest in flying is indicated by the 3.8 million personal flying hours flown in 1964. It is estimated that this will increase to 7.6 million hours in 1975. An additional indication is the number of youthful pilots in the U. S., 15 per cent, (or 71,689) are between the ages of 16 and 24. Among student pilots who are learning to fly, the under-25 age

---

<sup>1</sup>Leslie L. Thomason, A Summary of The Curtis Commission Report Forecasts (Wichita, Kansas, Cessna Aircraft Co., 1955).

<sup>2</sup>Utility Airplane Council of Aerospace Industries Association, General Aviation--Today and Tomorrow (Washington, D.C., 1965).

group accounts for an even larger portion of the total--37 per cent. Teenagers alone make up 12 per cent of the nation's student pilots--even though they may not fly solo in a private plane before their 16th birthday.<sup>1</sup>

In the Space Age the aerospace industries are to represent the greatest growth potentials, the greatest opportunity for inventiveness, and the most demanding field for training requirements of any American industry.

---

<sup>1</sup>Senate Committee on Govt. Operations, Ide K. Boltz, loc. cit.



## CHAPTER IV

### AEROSPACE SCIENCE-COURSE OUTLINE

This chapter of the writer's report will contain the outlined course of study for Aerospace Science--Dexfield Community High School. The outline is intended for the use of the teacher but, if it will aid the student, parts may be reproduced and included in student material.

Each chapter of the outline will be followed by, "ENRICHMENT AND TEACHER AIDS." The purpose of this section of each chapter is to aid the teacher in the subject matter and to facilitate the occupational objective of the course.

The basic text for Aerospace Science is, FUNDAMENTALS OF AVIATION AND SPACE TECHNOLOGY, Institute of Aviation, University of Illinois, Urbana, Illinois, 61801.

The outlined course of study is presented in the following pages.

AEROSPACE SCIENCE

for

Dexfield Community High School

Redfield, Iowa

Aims - Objectives

Course Outline

Teacher Aids & Enrichment

LIBRARY

## TABLE OF CONTENTS

CHAPTER	PAGE
INTRODUCTION . . . . .	a
AIMS AND OBJECTIVES . . . . .	0-1
Aims of Aerospace Science . . . . .	0-1
Objectives of Aerospace Science . . . . .	0-1
ONE . . . . .	0-3
Unit I - Living in the Aerospace Age . . . . .	0-3
Enrichment and Teacher Aids . . . . .	0-6
TWO . . . . .	0-24
Unit I - History of Flight and Air Transportation . . . . .	0-24
Unit II - Theory of Flight . . . . .	0-26
Unit III - Flight Technique . . . . .	0-28
Enrichment and Teacher Aids . . . . .	0-29
THREE . . . . .	0-40
Unit I - Aircraft . . . . .	0-40
Unit II - Aircraft Powerplants . . . . .	0-44
Unit III - Aircraft Instruments . . . . .	0-47
Enrichment and Teacher Aids . . . . .	0-49
FOUR . . . . .	0-59
Unit I - Navigation . . . . .	0-59
Unit II - Meteorology . . . . .	0-62
Enrichment and Teacher Aids . . . . .	0-66

NATIONAL LIBRARY

CHAPTER	PAGE
FIVE . . . . .	0-73
Unit I - Air Traffic Control	
and Communications . . . . .	0-73
Unit II - Dept. of Transportation--FAA . . .	0-75
Enrichment and Teacher Aids . . . . .	0-80
SIX . . . . .	0-88
Unit I - Space Travel . . . . .	0-88
Unit II - Unmanned Space Exploration . . . .	0-91
Unit III - Manned Exploration . . . . .	0-92
Enrichment and Teacher Aids . . . . .	0-93
APPENDIX A. Engineering, Technical, and Trade Schools	0-105
APPENDIX B. Scholarships and Financial Aids . . . .	0-116
APPENDIX C. Identification and Addresses of	
Film Sources . . . . .	0-120
APPENDIX D. Identification and Addresses of	
Free or Inexpensive Materials . . . . .	0-122
APPENDIX E. Publishers of Aviation and Space	
Periodicals . . . . .	0-126
APPENDIX F. Miscellaneous Reference Sources . . . .	0-128

## AEROSPACE SCIENCE

### Introduction

Since the beginning of recorded time, man's inventive-ness and curiosity have made the world an ever-shrinking body. Man has used: his legs, wheels, boats, carts pulled by animals, oars and sails on his boats, steam, and internal combustion power to transport him from place to place. Each step in the sophistication of transportation was evidenced by an increase in the speed and efficiency of man's mode of transportation. This was all done to satisfy man's innate curiosity to find out what is just beyond the horizon.

Man probably looked at the birds in the sky and dreamed a little. If he could just fly he would not have to be limited to roads, rails, and rivers in his travel. He could go where he wanted and not have to contend with obstacles in his path or be content with only a few miles of travel a day.

Civilization after civilization dreamed of flying like the birds. Historical records show us dreams and attempts of the Chinese, Egyptians, Greeks, Romans, and modern European and American men. In December of 1903 Wilbur and Orville Wright of Ohio completed the first manned flight of a heavier-than-air craft. This first flight lasted only a few seconds and covered less distance than

b

the wing span of a modern jet airliner. Man was on his way to cutting his bonds with earth and exploring a new element.

Since the early days of aviation aeronautics has developed into an exact science governed by natural law. The intricacies of flying have been learned by millions. Aircraft are used daily for many tasks. Millions of workers are employed in the aviation and related industries. It is possible to race the sun around the world, and win. A trip from New York to California takes a little less than four hours on a non-stop jet airliner. Medical supplies can be dropped into areas that would otherwise be inaccessible for days or even weeks due to weather conditions. Mail is carried, hospital patients transferred to other hospitals through the use of air ambulance services, and foods, sometimes fresher than those you can grow in your own garden, can be on your table thanks to air freight. The airplane has shrunk the world.

Man is now prepared to cast off another bond and explore in the element beyond his atmosphere. Man is preparing to go into outer space. Man is preparing to learn the mysteries, first hand, of the moon, planets, and possibly the universe.

Man will undoubtedly get to where he wants to go because of his inventiveness and curiosity. But, as in the past, man will have to be helped on his way. As the

contributions of Lilienthall and Chanute aided the Wright Brothers, so will the present experiments in space travel aid those who explore and invent in the future.

Aerospace Science is relatively new on our science frontier. This science is not only concerned with aerospace travel but, with the supporting elements of aerospace travel. People on the ground contributing maintenance and technological know-how and those people working in allied industries contributing to aerospace travel. Aerospace travel is thus a proper mixture of all of these elements culminating in successful flight.

It is with this "proper mixture" in mind that Aerospace Science has been developed for the Dexfield Community High School. Aerospace Science is a course that will give the student a background in aeronautics, navigation, meteorology, and the sciences involved in space exploration. At the same time the student will be made aware of the tremendous career potentials in the aerospace and related industries. Correlated with the course work will be visits to aerospace and related facilities so that the student may observe, first hand, what he is studying.

Just as aerospace exploration is a tremendous challenge to the world, aerospace education is a tremendous challenge to the school. Aerospace Science will help meet this challenge.

## AEROSPACE SCIENCE - AIMS AND OBJECTIVES

### Aims of Aerospace Science are:

1. To understand the facts and methods of Aerospace Science, and the influence of Aerospace upon human life.
2. To develop, through Aerospace Science study, an interest in a salable skill and those characteristics that make the worker a thoughtful, productive, and honest participant in economic life.
3. To develop a science course of sufficient unique characteristics and content so as to attract those science students who would have otherwise terminated their science studies after successful completion of the more traditional science requirements and electives.

Objectives of Aerospace Science are to provide the student with:

1. An adequate reading and speaking vocabulary of things aeronautic and astronautic.
2. An understanding of the importance of weather and climate to flight operations.
3. An understanding of the importance of the physical and biological science to space operations.
4. A general knowledge and understanding of the structural requirements for terrestrial and extra-terrestrial vehicles.
5. An understanding of aerospace industry in peace and war.
6. An understanding of the effects of the Aerospace Age on international relations.
7. An introduction to the social, economic, and political implications of current and future aerospace developments.



8. An appreciation of the services rendered by airports and their associated personnel.
9. Familiarity with existing and needed basic governmental services and regulations.
10. A knowledge of available aerospace education resources in materials, personnel, and equipment.
11. An understanding of problems--political, economic, international, and social--that have been created by the Aerospace Age.
12. A realization of how the aerospace vehicle has changed geographic relationships, particularly in terms of mankind's attitudes towards land masses, water barriers, and space travel.
13. A knowledge of career potentials in the science, engineering, maintenance, and related areas of aerospace vehicle development, manufacture, and operation.
14. An understanding of the underlying scientific principles basic to aerospace vehicle development and operation.<sup>1</sup>

---

<sup>1</sup>Civil Air Patrol, Aerospace Education Course Syllabus (Ellington AFB, Texas, 1963), p. 2.

# AEROSPACE SCIENCE

## COURSE OUTLINE

### CHAPTER ONE

#### Unit I Living In The Aerospace Age

##### A. Economic Aspect

##### 1. Aerospace Manufacturing Industry

- a) Aircraft
- b) Engines (piston & turbine)
- c) Parts & accessories
- d) Missiles
- e) Spacecraft

##### 2. Air Transport Industry

- a) Domestic Schedules Airlines
  - (1) Trunk lines
  - (2) Local-service lines
  - (3) Connecting lines
  - (4) Helicopter airlines
  - (5) All-cargo airlines
- b) International Carriers (passengers and cargo)

##### 3. General Aviation

- a) Business flying
- b) Commercial flying

- (1) Air taxi (charter)
- (2) Air ambulance
- (3) Aerial chemical application
- (4) Aerial advertising
- (5) Aerial photography
- (6) Aerial cartography
- (7) Other uses
- c) Instructional Flying
  - (1) University & college training
  - (2) Flight schools
- d) Personal Flying

## B. Social Aspect

- 1. Population Distribution
  - a) Population mobility
  - b) Inter-changing cultures
- 2. Education
  - a) Aeronautical engineering degree schools
  - b) Aerospace trade schools
- 3. Family Life
  - a) Leisure time pursuits
  - b) Decentralization of family without weakening ties
  - c) Consumer products--goods, foods, and services

DRAKE LIBRARY

## C. Political Aspect

1. Military operations--Air Force, Army, Navy, and Marines
  - a) Mission during peace time
  - b) Mission during war time
2. International affairs
  - a) Diplomacy
  - b) Good will
  - c) International politics
3. Politics
  - a) Campaigns, national and state
  - b) Mobility of elected officials

## CHAPTER I ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

- Aerospace Industries Association of America, Inc. 1965, 1966, 1967 Aerospace Facts and Figures. 1725 De Sales Street, N.W., Washington, D.C. 20036.
- \_\_\_\_\_. 1965, 1966, 1967 Annual Report. 1725 De Sales Street, N.W., Washington, D.C. 20036.
- \_\_\_\_\_. The Aerospace Industry--Today and Tomorrow. 1725 De Sales Street, N.W., Washington, D.C. 20036.
- \_\_\_\_\_. Around The World In 48 Hours. 1725 De Sales Street, N.W., Washington, D.C. 20036.
- \_\_\_\_\_. Legislation: Speeding Space Progress. 1725 De Sales Street, N.W., Washington, D.C. 20036.
- Air Transport Association of America. 1965, 1966, 1967 Facts & Figures--Air Transportation. 1000 Connecticut Ave., N.W., Washington, D.C. 20036.
- \_\_\_\_\_. A Half-Century Of Progress In Scheduled Air Transportation. 1000 Connecticut Ave., N.W., Washington, D.C. 20036.
- \_\_\_\_\_. The Vital Link. 1000 Connecticut Ave., N.W. Washington, D.C. 20036.
- American Airlines, Inc. How Local Airlines Put Main Street On The Map. 633 Third Ave., New York, New York 10017.
- Cessna Aircraft Co. Summary The Curtis Commission Report Forecasts. Wichita, Kansas.
- \_\_\_\_\_. Here's How To Make Flying A Family Affair! Wichita, Kansas.
- \_\_\_\_\_. What Every Woman Should Know About Flying! Wichita, Kansas.
- \_\_\_\_\_. Who Me Fly? My Own Airplane! Wichita, Kansas.

- Flying Tiger Line, Inc. "Can Do" The Story Of An Airline.  
Los Angeles International Airport, California 90009.
- The Goodyear Tire & Rubber Co. Learning To Fly. Akron,  
Ohio 44316.
- Illinois Bell Telephone Co. The Space Age. Chicago, Ill.
- Jeppeson & Co. Who Me? Fly An Airplane? 8025 E. 40th Ave.,  
Denver, Colorado 80207.
- Martin-Marietta Co. 1964, 1965, 1966, and 1967 Contributions To Science & Technology. Friendship International  
Airport, Maryland 21240.
- Mehrens, H. E. The Aerospace Age. Maxwell AFB, Alabama:  
Civil Air Patrol, 1963.
- \_\_\_\_\_. The Dawning Space Age. Maxwell AFB, Alabama:  
Civil Air Patrol, 1963.
- Merrill Lynch, Pierce, Fenner & Smith, Inc. Aerospace.  
New York.
- National Aerospace Education Council. Aerospace Highlights.  
806 15th St., N.W., Washington, D.C. 20005.
- \_\_\_\_\_. The Farmer's Wings. 806 15th St., N.W., Wash-  
ington, D.C. 20005.
- \_\_\_\_\_. Flying Cargo. 806 15th St., N.W., Washington,  
D.C. 20005.
- \_\_\_\_\_. General Aviation, Today and Tomorrow. 806 15th  
St., N.W., Washington, D.C. 20005.
- Pan American World Airways, Inc. Aviation's One World In  
The Jet Age. Pan Am Building, New York, New York 10017.
- \_\_\_\_\_. The Flying Clippers. Pan Am Building, New York,  
New York 10017.
- Piper Aircraft Corp. Add An Airpark. Lockhaven, Pennsyl-  
vania.
- Texas Aeronautical Commission. Importance Of A Modern  
Airport. Austin, Texas.

United Air Lines. Jet Age Flight. O'Hare International Airport, Chicago, Illinois 60666.

\_\_\_\_\_. The Airport and Your Community. O'Hare International Airport, Chicago, Illinois 60666.

United States Air Force. Foundations of Air Power. HQAFROTC, Maxwell AFB, Alabama 36112.

\_\_\_\_\_. Questions and Answers About The Air Force. Secretary of the Air Force, Washington, D.C.

\_\_\_\_\_. The United States Air Force. Secretary of the Air Force, Washington, D.C.

\_\_\_\_\_. The Strategic Air Command. Secretary of the Air Force, Washington, D.C.

United States Dept. of Agriculture. That Land Down There. Secretary of Agriculture, Washington, D.C.

United States Dept. of Transportation. Summary of National Aviation Goals. Administrator, Federal Aviation Agency, Washington, D.C.

#### SELECTIONS FROM PERIODICALS

Cushman, Jack. "Future Flyers Are In School," Air Facts (August, 1965: reprinted and distributed by the National Aerospace Education Council, 806 15th St., N.W., Washington, D.C. 20005).

Editorial Staff. "New Five-Year National Airport Plan Places Emphasis on General Aviation," The AOPA Pilot (November, 1964), 83.

Le May, Gen. Curtis E. "Power For Peace," National Geographic (September, 1965), 291-296.

Thomason, Dr. Leslie L. "Let's Build General Aviation Up Again," Flight (reprinted and distributed by Cessna Aircraft Co., Wichita, Kansas).

- \_\_\_\_\_. "Portrait of the Single-Engine Owner," Flying (November, 1963).
- \_\_\_\_\_. "Rebirth of an Airport," Air Facts (reprinted and distributed by the National Aerospace Education Council, 806 15th St., N.W., Washington, D.C. 20005).
- \_\_\_\_\_. "The Public and Lightplanes," The AOPA Pilot (June, 1961: reprinted and distributed by Cessna Aircraft Co., Wichita, Kansas).
- \_\_\_\_\_. "Your Wings are Showing!" Future (January, 1961).
- Weaver, Kenneth F. "Of Planes and Men," National Geographic (September, 1965), 298-349.

#### COMPANY JOURNALS

The following journals of aerospace industry are available and the requestor may have his name placed on the mailing list for future copies. These journals and publications contain information of the company's research and progress as well as general interest articles.

AEROSPACE, Aerospace Industries Association of America, Inc.,  
1725 De Sales Ave., N.W., Washington, D.C. 20036.

AVIATION BULLETIN, Iowa Aeronautics Commission, State House,  
Des Moines, Iowa.

NATIONAL AERONAUTICS, National Aeronautic Association,  
1025 Connecticut Ave., N.W., Washington, D.C.

PROGRESS REPORT, Douglas Aircraft Group, Aircraft Division,  
3855 Lakewood Blvd., Longbeach, California.



- ROCKET REVIEW, Aerojet-General Corporation, A Subsidiary of the General Tire and Rubber Co.
- SKYLIGHTS, National Aerospace Education Council, 806 15th St., N.W., Washington, D.C. 20006.
- SKYLINE, North American Rockwell Corp., Aerospace and Systems Group, El Segundo, California 90246.
- SPERRYSCOPE, Sperry Rand Corp., 1290 Ave. of the Americas, New York, New York 10019.
- VECTORS, Hughes Aircraft Co., Culver City, California.

## SELECTED READINGS IN CAREERS AND OCCUPATIONS

- Cessna Aircraft Co. What Are You Going To Do With The Next Half Century? Wichita, Kansas.
- Editorial Staff. "Careers in Aviation," Flying (August, 1963).
- National Aerospace Education Council. Seven Steps To A Career In Space Science and Technology, 806 15th St., N.W., Washington, D.C. 20006.
- Stickler, Dr. Mervin K. and Walter Zaharevitz. "Career Opportunities in Aviation," American Modeler and Air Transport World (reprinted and distributed by the National Aerospace Education Council, 806 15th St., N.W., Washington, D.C. 20006).
- United States Congress, Senate, Committee on Govt. Operations, Statement made by Ide K. Boltz, President, National Aerospace Education Council, hearing before Committee, 90th Congress, 1st. Session, on S. 1602, October 27, 1967 (Washington, D.C.: Govt. Printing Office, 1967).
- United States Dept. of Health, Education, and Welfare, Office of Education. Selected Aerospace Career and Scholarship Information, Circular No. 569B. Washington: Govt. Printing Office, 1962.

United States Dept. of Labor, Bureau of Labor Statistics.  
 "Employment Outlook In Aircraft, Missile, and Space-  
 craft Manufacturing Occupations," Occupational Outlook  
Handbook Bulletin No. 1490-93. Washington: Govt.  
 Printing Office, 1966-67.

\_\_\_\_\_. "Employment Outlook In Civil Aviation," Occupa-  
tional Outlook Handbook Bulletin No. 1450-96. Washing-  
 ton: Govt. Printing Office, 1966-67.

\_\_\_\_\_. "New Job Horizons In Defense-Related Work,"  
Occupational Outlook Quarterly, Vol. 7, No. 4. Washing-  
 ton: Govt. Printing Office, December, 1963.

\_\_\_\_\_. "Strange New World," Occupational Outlook Quar-  
terly, Vol 7, No. 2. Washington: Govt. Printing Office,  
 May, 1963.

\_\_\_\_\_. Occupational Outlook Quarterly, Vol. 10, No. 2.  
 Washington: Govt. Printing Office, May, 1966.

\_\_\_\_\_. Occupational Outlook Quarterly, Vol. 11, No. 4.  
 Washington: Govt. Printing Office, December, 1967.

University of Illinois Institute of Aviation. Careers In  
Aviation. Urbana, Illinois.

#### FILM SUGGESTIONS

Airplane Changes Our World Map	U-1227	sui
Flight 803		mtps
Mr. Withers Stops The Clock	# 27	iac
Song Of The Clouds	# 50	iac
The Mission Of The U. S. Air Force	OC-13	af
Wings For Doubting Thomas		ces
Introduction To Aerospace (filmstrip)		cap

## ACTIVITIES AND PROJECTS

1. Construct maps showing commercial air routes.
2. Reports on: Air Freight; Aerospace Manufacturing in the U.S.A.; General Aviation Trends; and How Aviation Has Changed Military Thinking.
3. A talk by a local airport operator or a fixed base operator at a large municipal airport.
4. Field trips to: SAC Headquarters, Offutt AFB, Omaha, Nebraska; and the Air National Guard in Des Moines.
5. Reports on occupational areas in aerospace manufacturing, civil aviation, etc.

## OCCUPATIONAL AREAS - CHAPTER I

Dictionary of Occupational Titles, 3rd edition,  
numerical classifications are used.

## AEROSPACE MANUFACTURING INDUSTRY

Research & Design

Aerodynamicist	002.081
Aerodynamics Engineer	002.081
Aeronautical Engineer	002.081
Aerophysics Engineer	002.081
Aerospace Engineer	002.081
Aircraft Designer	002.081
Astronomer	021.088
Ceramic Engineer	006.081
Chemical Engineer	008.081
Chemist	022.081
Electrical Engineer	003.081 & .087
Electronics Engineer	003.081
Industrial Engineer	012.081
Mathematician	020.088
Mechanical Engineer	007.081
Metallurgical Engineer	011.081

Metallurgist	011.081
Nuclear Engineer	015.081
Physicist	023.081 & .088
Test Pilot	196.283

### Technicians

Aerodynamics Analyst	011.381
Ceramic Analyst	006.081
Computer Programmer	007.187
Design Draftsman	002.281
Electronic Technician	003.181
Engineering Aid	007.181
Engineering Technician	007.181
Experimental Technicians	007.181
Mathematics Aid	020.188
Physical Science Aid	011.281
Powerplant Technician	621.281
Stress Analyst	002.281
Systems Test Technician	020.088
Technical Illustrator	017.281
Technical Writer	139.288
Tool Designer	007.081

## PLANT OCCUPATIONS

### Sheet Metal

Sheetmetal Worker	804.281
Powerbrake Operator	617.380
Powerhammer Operator	617.782
Powershear Operator	615.782 & .885
Punchpress	615.282
Profile Cutting Machine Operator	816.782
Tube Bender (hydraulic & elec.)	709.884
Riveter	800.884
Welder	810.782 810.884
	811.782 811.884
Heat Treater	504.782
Painter	845.781
Plater	500.380

Machining & Testing

Machinist	600.280 & .281
Machine Tool Operator	609.885
Jig & Fixture Builder	761.381
Tool & Die Maker	601.280

Inspecting & Testing

Outside Production Inspector	806.381
Receiving Inspector	806.384
Machine Parts Inspector	609.381
Fabrication Inspector	607.381
Assembly Inspector	806.381

Assembly & Installation

Final Assembler	806.781
Missile Assembly Mechanic	652.281
Powerplant Installer	621.381
Electrical Assembler	728.884
Armament Assembler	801.381
Airplane Woodworker	729.281
Radio Installer	823.281

Flight Checkout

Chief Mechanic	621.281
Engine Mechanic	621.281
Electronics Checkout Man	825.281

Material Handling, Maintenance, and Custodial

Truck Driver	Carpenter
Stock Clerk	Plumber
Shipping	Guard
Tool Crib Attendant	Fireman
Maintenance Mechanic	Janitor
Millwright	

## AIR TRANSPORTATION

Flight Operations

Chief Pilot	196.168
Instructor Pilot	196.128
Captain	196.268
Co-Pilot	196.283
Flight Engineer	621.281
Steward or Stewardess	352.878
Flight Dispatcher	912.368
Meteorologist	025.088

Airline Communication

Ground Radio Operator	193.168 & .282
Teletypist	203.588

Airline Maintenance

Maintenance Inspector	621.281
A & E Mechanic	621.281
Instrument Technician	710.281
Radio Technician	825.381

Airline Office and Sales

District Sales Manager	163.118
District & Operations Station Mgr.	184.118
Sales Representative	252.358
Reservation Agent	912.368
Ticket Agent	919.368
Passenger Service Agent	184.168
Air Freight Agent	912.368
Lineman	912.887
Ramp Agent	912.368
Public Relations Representative	165.068
Personnel Representative	166.118
Research Analyst	020.168
Programmer	020.188
Accountant	160.188

Engineers

Engineering positions in the Air Transportation Industry are the same D.O.T. classifications as aerospace manufacturing industry. Air Transportation engineers work with aircraft manufacturers to convey airline needs for a particular operation.

Office Personnel

Business Machine Operator	Stenographer
Switchboard Operator	Typist
Secretary	File Clerk

## GENERAL AVIATION

Pilot

Agriculture Pilot	196.283
Commercial Pilot	196.283
Highway Patrol Pilot	375.168
Instructor Pilot	196.228
Conservation Pilot	180.168

Maintenance

Aircraft & Engine Mechanic	621.281 & .884
Overhaul Mechanic	621.281
Radio Mechanic	823.281
Instrument Mechanic	710.281
Propeller Mechanic	600.381

Administration

Manager	(Many classes--Business, Airport, etc.)
Sales	280.258 & .358
Clerical	(Usual office classes.)

## MILITARY

See recruiting booklets and manuals for occupations in the Air Force and aviation branch of the other services. The occupations are similar to civilian positions; however, there are some military specialities.

## ELECTRONIC AND COMPUTER INDUSTRIES

Administrative

Electronic Engineer	003.081
Computer Engineer	020.088
Computer Systems Engineer	003.187
Data Processing	012.168
Electronic Technician	003.181

Manufacturing

Assembly	729.884	720.884
	726.781	726.884

Fabricating

Glass Blowing & Glass Lathe	674.782
Grid Lathe	925.884
Coil Winders	724.781 & .884
Crystal Grinders & Finishers	726.884 & .085

Processing

Electroplaters & Tanners	501.885
Anodizer	501.282
Silk Screen Operator	726.887
Etching	590.885
Operator--Infrared Oven & Hydrogen Furnace Fires	590.885
Exhaust Operator	725.884
Sealers	692.885



Testing & Inspecting

Electronics Assembly Inspector	722.281
--------------------------------	---------

## AIRPORT

Administration

Airport Superintendent	184.118
Airport Engineer	005.081

Maintenance

Airport Electrician	824.781
Airport Maintenance Chief	899.137
Airport Serviceman	912.384

## SOURCES OF OCCUPATIONAL INFORMATION

The firms, or organizations, listed in this section will supply occupational information free or at a small cost.

Aerojet-General Corp. Spacelines. Public Relations, P. O. Box 702, 9100 E. Flair Drive, El Monte, Calif. 91734, (free).

Air Transport Association of America. Career Opportunities With The Airlines. 1000 Connecticut Ave., N.W., Washington, D.C. 20036 (free).

American Astronomical Society. A Career In Astronomy. Princeton University Observatory, 211 Fitz Randolph Rd., Princeton, New Jersey 08540 (free).

American Ceramic Society, Inc. For Career Opportunities Explore The Wonder World Of Ceramics. 4055 N. High St., Columbus, Ohio 43214 (free).

American Chemical Society. Shall I Study Chemistry? 1155 Sixteenth St., N.W., Washington, D.C. 20036 (free).

American Electroplaters' Society, Inc. Introduction To Electroplating. 443 Broad Street, Newark, New Jersey 07102 (35¢).

American Federation of Labor and Congress of Industrial Organization--Education Dept. Electrical Workers #49, Communication Workers #28, Aircraft Machinists #43, Machinists #10, Airline Workers #66, Missile Makers #90, Consultant, Guidance Services, State of Iowa, Des Moines, Iowa 50319 (free loan films).

American Institute of Aeronautics and Astronautics. Your Career as an Aerospace Engineer. 1290 Sixth Ave., New York, New York 10019 (free).

American Institute of Chemical Engineers. Will You Be A Chemical Engineer? 345 East 47 St., New York, New York 10017 (free).

American Institute of Industrial Engineers. Industrial Engineering. 345 East 47 St., New York, New York 10017 (free).

American Institute of Physics. Physics As A Career. 335 East 45 St., New York, New York 10017 (free).

American Meteorological Society. The Challenge of Meteorology. 45 Beacon St., Boston, Mass. 02108 (free).

American Society For Engineering Education. Technician Career Opportunities In Engineering Technology and Education Of The Engineering Technician. Publication and Reprints, Dupont Circle Bldg., 1346 Connecticut Ave., N.W., Washington, D.C. 20036 (50¢ and \$1.25).

American Society For Metals. A Career In Metallurgy Will Extend Your Reach and The Searching Man (film). Metals Park, Ohio 44073 (25¢ and free loan).

American Society of Tool & Manufacturing Engineers. Careers In Tool and Manufacturing Engineering and Should You Be A Manufacturing Engineer? 20501 Dearborn, Michigan 48128 (both free).

American Welding Society, Inc. Opportunities In The Welding Industry. Information Dept., 345 East 47 St., New York, New York 10017 (free).

Data Processing Management Association. Your Career In Data Processing and ABC's Of ADP. 505 Busse Highway, Park Ridge, Illinois 60068 (2¢ and free).

Eastman Kodak Company. Photography In Your Future. (T-15). Public Relations Dept., General Offices 343 State St., Rochester, New York 14650 (free).

E. I. Du Pont De Nemours And Co.--Public Relations Dept. Careers in Engineering, Careers at Du Pont In Chemistry and Chemical Engineering, The Challenge of Industrial Change, and The Industry of Discovery. Wilmington, Delaware 19898 (all free).

Electronic Computer Programming Institute. Programming A New Profession For You. Empire State Building, New York, New York 10016 (free).

E. P. Dutton And Company. Careers And Opportunities In Electronics, (\$3.95), Careers And Opportunities In Astronautics, (\$3.95), Careers & Opportunities In Chemistry, (\$3.75), Careers & Opportunities In Engineering, (\$3.75), 201 Park Ave. South, New York, New York 10003.

Ford Foundation. Essentials Of Manpower Planning In Economic Development and Ford Foundation's Role In Engineering Education. Office of Reports, 477 Madison Ave., New York, New York 10022 (both free).

General Motors Corp. Can I Be A Technician?, Can I Be An Engineer?, Can I Be A Craftsman?, Can I Be A Draftsman?, Can I Be A Mathematician? Public Relations Staff, General Motors Bldg., Detroit, Michigan 48202 (all free).

International Association of Machinists And Aerospace Workers. Careers In The Crafts. 1300 Connecticut Ave., N.W., Washington, D.C. 20036 (free).

J. B. Lippincott Company. American Women Of Science and Modern American Engineers. East Washington Square, Philadelphia, Pennsylvania 19105 (both \$3.95).

- J. Weston Walch, Publisher. Opportunities In Mathematics and Opportunities In Science. Portland, Maine 04104 (both \$1.00).
- Manufacturing Chemists' Association, Inc. Careers Ahead In The Chemical Industry and A Bright Future For You As A Chemical Technician. 1825 Connecticut Ave., N.W., Washington, D.C. 20009 (both free).
- Material Handling Institute, Inc. Career Opportunities For You In Material Handling. Educational Division, Gateway Towers, Pittsburgh, Pa. 15222 (free).
- Mathematical Association of America. Guidebook To Departments In The Mathematical Sciences. SUNY at Buffalo, Buffalo, New York 14214 (50¢).
- Michigan Technological University. Electrical Engineering Technology. Houghton, Michigan 49931 (25¢).
- N.E.A.--National Science Teachers Association. Computers--Theory and Uses and Keys To Careers In Science and Technology. 1201 Sixteenth Street, N.W., Washington, D.C., 20036 (both \$1.00).
- National Guard Bureau. This Is The Air National Guard. The Pentagon, Washington, D.C. 20310 (free).
- National Society Of Professional Engineers. Engineering... A Career Opportunity. 2029 K Street, N.W., Washington, D.C. 20006 (free).
- R.C.A. Institutes, Inc. Your Future In Electronics (film). 350 West 4th Street, New York, New York 10014 (free loan).
- Refractories Institute. From Firelight To Satellite. First National Bank Building, Pittsburgh, Pa. 15222 (free).
- Society Of Plastics Engineers. Plastics As An Engineering Career. 65 Prospect Street, Samford, Connecticut 06902 (free).
- Serling Movies U.S.A., Inc. Engineer: Man Of Destiny (film). 43 W. 61st St., New York, New York 10023 (free loan).

U.S. Dept. of Commerce--Bureau of Public Roads. Challenging Career In Electronic Data Processing. Distribution Section, Room 267, 1717 H Street, N.W., Washington, D.C. 20235 (free).

U.S. Dept. Of Defense --Dept. of The Air Force, Air Force Film Library. Your Future And The Air Force Institute Of Technology. SFP 1015. (film). Air Force Film Library, 8900 South Broadway, St. Louis, Missouri 63125 (free loan).

U.S. Dept. of Health, Education, and Welfare--Office of Education. Careers In Technical Occupations. Supt. of Documents, Government Printing Office, Washington, D.C. 20402 (5¢).

National Aeronautics And Space Administration. NASA, Twentieth Century Explorer and NASA Employment Fact Sheet. Code FAD-1, Washington, D.C. 20546 (both free).

University of Illinois--Dept. of Ceramic Engineering. A Look Into The World Of Ceramics. Urbana, Illinois 61801 (free).

University of Missouri At Rolla. Electrical Engineering, Chemical Engineering, Chemistry, Mechanical Engineering Applied Mathematics, Nuclear Engineering, Physics, and Computer Science. Rolla, Missouri 65401 (all free).

#### FREE OR INEXPENSIVE MATERIALS

The Age Of Flight (free)	uac
Contact To Countdown (free)	hs
North American Aviation (free)	naa
Planning the Airport Industrial Park (free)	faa
The Airport and Your Community (free)	ual
Demonstration Aids For Aviation Education (free)	faa
The Challenges to U. S. Civil Air Transport (free)	cgl

0-23

The Air Express **Story** (free)

rea

Airline Route Map (free)

tex

Protecting The Forests From Fire (free)

dag

General Aviation And Its Relationship

To Industry And The Community (free)

faa

DRAKE LIBRARY

## CHAPTER TWO

## Unit I History of Flight and Air Transportation

## A. Ancients

1. Mythology
2. Leonardo da Vinci

## B. Balloons and Gliders

1. Sir George Cayley
2. Besnier
3. Montgolfier Brothers
4. Henri Giffard
5. David Swartz
6. von Zeppelin
7. Octave Chanute
8. Lilienthal
9. John Montgomery
10. Langley
11. John Stringfellow
12. Charles Manley
13. Wright Brothers

## C. Man's First Flight

## D. Later Developments

1. Glen Curtis
2. Louis Bleriot
3. C. K. Hamilton

E. Contributors To Aircraft Development

1. Military Aviation
2. National Air Races
3. Round-The-World and Endurance Flights

F. Air Mail, Air Passenger, Air Freight Development

1. Kelley Act, 1925
2. Air Commerce Act, 1926
3. Black-Mc Keller Act, 1934
4. Civil Aeronautics Acts, 1938 & 1940
5. Truman Committee, 1947-48



## Unit II Theory of Flight

## A. Shape of wing

1. Airfoil
2. Camber
3. Chord - Span
4. Aspect Ratio

## B. Lift

1. Speed of Wing
2. Angle of Attack
3. Air Temperature
4. Air Pressure
5. Center of Lift
6. Center of Pressure
7. Relative Wind
8. Change of camber
9. Burble
10. Stall
11. Bernoulli's Principle

## C. Weight - Thrust - Drag

## D. Axes of Rotation

1. Longitudinal
2. Horizontal
3. Vertical

E. Stability

1. Static
2. Dynamic
3. Around Axes

F. Control Surfaces

1. Rudder
2. Elevators
  - a) Canards
3. Ailerons
4. Trim Tabs

## Unit III Flight Technique

## A. Pre-Flight

1. Walk-Around Inspection
2. Starting The Engine
  - a) Temperature & Pressure Guages
3. Taxiing
4. Engine Run-Up

## B. The Take Off

## C. Airplane Attitude and Use of Controls

1. Controls
2. Straight and Level Flight
3. The Climb
4. The Descent (glide)
  - a) Use of Engine in Changing Attitude
5. Coordination of Controls
  - a) The Turn
  - b) Rate of Turn
  - c) Slipping--Skidding
6. Stall

## D. Airport Traffic Patterns

1. Departure and Entry
2. The Four Legs

## E. Landing Approach

## F. Tiedown

## CHAPTER II ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

Unit I

Bernt Balchen and Erick Berghust. The Next Fifty Years of Flight. New York City: The Viking Press, 1960.

Arnold E. Briddon, FAA Historian. FAA Historical Fact Book--A Chronology, 1926-1963. Washington, D.C.: Govt. Printing Office, 1966.

Louis S. Casey. The First Nonstop Coast-To-Coast Flight and The Historic T-2 Airplane. Vol. 1 No. 1 of Smithsonian Annals of Flight. Washington, D.C.: Govt. Printing Office, 1964.

Courtland Canby. A History of Flight. New York City: Hawthorne Books, Inc., 1963.

Basil Clark. Polar Flight. London: Ian Allan, 1964.

\_\_\_\_\_. The History of Airships. London: Herbert Jenkins, 1961.

David C. Cooke. Flights That Made History. New York City: G. P. Putnam's Son, 1961.

\_\_\_\_\_. Who Really Invented The Airplane? New York City: G. P. Putnam's Son, 1964.

Maj. Alexander P. de Seversky. Victory Through Airpower. Garden City, New York: Garden City Pub. Co., Inc., 1943.

Experimental Airplane Association. The Golden Age of Air Racing. Hales Corner, Wisconsin: FAA Air Museum Foundation, Inc., 1963.

Lt. Col. C. V. Glines, Editor. Polar Aviation. New York City: Franklin Watts, Inc., 1964.

Maj. Gene Gurney, USAF, Editor. Great Air Battles. New York City: Franklin Watts, Inc., 1963.

DRAKE LIBRARY

Alvin M. Josephy, Jr., Editor in Charge. The American Heritage History of Flight. Marion, Ohio: American Heritage Publishing Co., 1962.

Reed Kinert. Racing Planes and Air Races. 4 vols. Fallbrook, California: Aero Publishers, Inc., 1967.

Maj. James F. Sunderman, USAF, Editor. World War II in The Pacific. New York City: Bramhall House, 1962.

\_\_\_\_\_. World War II in Europe. New York City: Bramhall House, 1963.

United States Air Force. Foundations of Airpower. Maxwell AFB, Alabama: Headquarters AFROTC, 1958.

## Unit II

Department of Transportation, Federal Aviation Agency, Flight Standards Service. Private Pilot's Handbook of Aeronautical Knowledge (AC61-23). Washington, D.C.: Govt. Printing Office, 1965.

Ascher H. Shapiro. Shape and Flow. New York City: Doubleday and Company, Inc., 1961.

Brig. Gen. Neil D. van Sickle, USAF, Editor. Modern Airmanship. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1961.

## Unit III

Department of Transportation, Federal Aviation Agency, Flight Standards Service. Private Pilot's Handbook of Aeronautical Knowledge (AC61-23). Washington, D.C.: Govt. Printing Office, 1965.

Department of Transportation, Federal Aviation Agency, Flight Training Handbook. Washington, D.C.: Govt. Printing Office, 1965.

Brig. Gen. Neil D. van Sickle, USAF, Editor. Modern Air-  
manship. Princeton, New Jersey: D. Van Nostrand Co.,  
Inc., 1961.

Charles A. Zweng. Flight Instructor. North Hollywood,  
California: Pam American Navigation Service, 1965.

## SELECTIONS FROM PERIODICALS

### Unit I

Air Classics Editors, "Disasters Derby," Air Classics  
(Fall and March-April, 1965), 22 and 29.

Capt. Walter J. Boyne. "The Day The Steam Plane Flew,"  
Flying (December, 1962), 30.

Ora L. Jones. "I Missed Fame By A Mile At Kitty Hawk,"  
Pilot (December, 1964), 34.

Desmond Leigh-Hunt. "Dornier DO-X, First Ocean Airliner,"  
Flying (April, 1962), 44.

John Leyden. "Jimmie Doolittle--The First Instrumentalist,"  
FAA News (March, 1967), 10.

\_\_\_\_\_. "Saga Of The PN-9 No. 1," FAA News (November,  
1966), 10.

\_\_\_\_\_. "The Long Night Of The Lone Eagle," FAA News  
(April, 1967), 10.

\_\_\_\_\_. "Wiley Post--Man Who Shrank The Globe," FAA News  
(August, 1966), 11.

Joan Merriam. "The Longest Flight," Pilot (November, 1964),  
44.

Ed Mack Miller. "How They Flew The Airmail," Flying  
(August, 1966), 86.

Joe Mizrahi. "The Gee Bee," Air Classics (August-September,  
1965), 26.

\_\_\_\_\_. "Wedel-Williams Story," Air Classics (May-June,  
1964), 35.

DRAFT LIBRARY

- William Barry Murphy. "Pioneering The Pacific," Popular Aviation (November-December, 1967), 32.
- Henry R. Palmer. "The World's First Seaplane," Flying (June, 1962), 35.
- Col. Robert H. Rankin. "Aviation's Forgotten Man," Private Pilot (October-November, 1965), 76.
- Col. Bob Renneisen. "Orville Wright's Last Flight," Aerospace Historian (Spring, 1968), 29.
- Mabel Rodgers-Wiggins. "First Airmail Flight," Pilot (December, 1963), 38.
- H. Richard Shea. "1st Man In The Sky," FAA News (September, 1967), 11.
- \_\_\_\_\_. "First Commercial Airline In The World," FAA News (June, 1967), 12.
- Sue Silverman. "Saga Of The Ping Pong Flight," FAA News (December, 1966), 12.
- John Underwood. "Matty Laird Story," Air Progress (May, June, July, August, and September, 1967), 26, 43, 37, 52, and 45.
- Harriet Weber. "The First War In The Clouds," FAA News (December, 1967), 12.
- James H. Winchester. "Wiley Post," Popular Aviation (March-April, 1967), 26.

The following periodicals generally contain articles of historical interest in each issue;

AEROSPACE HISTORIAN

AIR CLASSICS

AIR PROGRESS

ANTIQUE AIRPLANE ASSOCIATION NEWS

SPORT FLYING

DRIFT LIBRARY

Unit II

John Ball. "The Wing That Breathes," Flying (April, 1964), 38.

Daniel Dommasch. "PSAS Spells In-Flight Stability," Pilot (November, 1964), 62.

F. Robert Morrison. "Flight Effects of Ground Effect," Pilot (November, 1964), 26.

Unit III

Donald Chase. "Short Field Ins and Outs," Pilot (July, 1963), 43.

Editorial Staff. "Fuel Exhaustion," Pilot (September, 1965), 77.

Betty Haeslop. "Brake It Easy," Flying (December, 1962), 50.

Morton J. Kaplan. "Proper Take-Off Attitude," Pilot (December, 1963), 62.

Virgil A. Kraft. "High Altitude Take-Off," Pilot (March, 1963), 43.

Barry Schiff. "Mystery Of Vanishing Airspeed," Private Pilot (December-January, 1966), 20.

Quinton M. Thomas, M.D. "Hypoxia and Carbon Monoxide," Flying (July, 1962), 52.

Turey K. Vickers. "Know Your Foe--Vortex," Pilot (August, 1965), 84.

Robert L. Wick, M.D. "Night Take-Off," Pilot (August, 1963), 34.

The following periodicals are specifically oriented toward up-grading pilot knowledge and skills.

AIR FACTS

AIRWAYS

DRIFT  
LIBRARY



## FILM SUGGESTIONS

Unit I

Air Maniacs	#73	iac
Ceilings Unlimited	#22	iac
Early Days (Pre 1930)	#52	iac
First Flight of The Wright Bros.	U-4173	sui
Five Steps to The Jets	1831	mtps
Fools, Daredevils, and Geniuses	#14	iac
Higher and Higher	#19	iac
Highlights of Aviation	#22	iac
Man In Flight	#57	iac
Men With Wings	AFMR 620	af
"1930"	#53	iac
We Saw It Happen	#39	iac

Unit II

Aerodynamics: Air Flow	TF 1-160	af
Aerodynamics: Forces Acting on Airfoil	TF 1-161	af
Airplane Structures--Control Surfaces	TF 1-700	af
Beyond The Stick and Rudder	TF 1-5300	af
How an Airplane Flies--Lift	#36	iac
How an Airplane Flies--Drag	#37	iac
How an Airplane Flies--Thrust & Forces	#40	iac

DRAFT COPY

How an Airplane Flies--Stability & Control	#41	iac
Principles of Flight	U-5464	sui
Theory of Flight	#46	iac

Unit III

Fly With Me		naa
One Eye On The Instruments	FA#209	faa
Primary Flight Controls	F3H-2N	mcd
Problems of Flight	U-874	sui
Safe for Solo	#31	iac
To Save A Life		aopa
Wings For The Beginner	#13	iac

## ACTIVITIES AND PROJECTS

Unit I

1. Reports on the contributors to aviation development.
2. Reports on air racing and its contributions to aircraft development and safety.
3. Make, or obtain, models showing the change of aircraft from 1903 to the present.
4. Prepare a bulletin board of historic and contemporary aircraft pictures.
5. Field trip to Des Moines Municipal Airport to see antique aircraft restored by Mr. Hud Weeks.
6. Field trip to Iowa Historical Building to look over the aviation exhibits.

7. Field trip to North Field in Des Moines and Ottumwa Municipal Airport to look over antique airplanes restored and flown by members of the Antique Airplane Association. (Ottumwa is the National Headquarters of the AAA.)

## Unit II

1. Construct gliders of balsa wood with various wing shapes and positions and fly them.
2. Build a wind tunnel.
3. Construct and test various airfoils in the wind tunnel.
4. Design an airplane, produce the sizes to pre-determined scale and construct it of balsa and other model airplane materials.
5. Field trip to Iowa State University, Department of Aerospace Engineering.
6. Report on occupations in aircraft research and development area.

## Unit III

1. Obtain, or build a small model airplane with working control surfaces to observe usual operation of the surfaces.
2. Fly U-Control model airplanes.
3. Field trip to an airport for actual aircraft orientation and a familiarization ride to demonstrate control functions and operations of instruments.
4. Report on occupations in flight training area.

## OCCUPATIONAL AREAS - CHAPTER II

Unit II

Aerodynamicist	002.081
Aerodynamics Engineer	002.081
Aeronautical Engineer	002.081
Test Pilot	
Aerodynamics Analyst	011.381

. . . also see occupational Area - Chapter I.

Unit III

Commercial Pilot	196.283
Instructor Pilot	196.228
Ground Instructor	

. . . also see Occupational Area - Chapter I.

## SOURCES OF OCCUPATIONAL INFORMATION

Unit II

Aerospace Industries Assn. of America, Inc., 1725 De Sales Street, N.W., Washington, D.C. 20036.

American Institute of Aeronautics and Astronautics, 1290 Sixth Ave., New York City 10019.

American Society For Engineering Education Technical Institute Council, 1346 Connecticut Ave., N.W., Washington, D.C. 20036.

. . . also see "Sources," Chapter I.

Unit III

Allied Pilots Association, 405 Lexington Ave., New York City 10017.

National Association of Flight Instructors, P.O. Box N,  
Washington, D.C. 20014.

National Business Aircraft Association, 425 13th St., N.W.,  
Washington, D.C.

. . . also see "Sources," Chapter I.

### FREE OR INEXPENSIVE MATERIALS

#### Unit I

Airplane Drawings--World Wars I & II (.50¢ ea.) a

Air Transportation Charts--Mile Stones in

Aviation (\$6.50) egi

Wright Bros. Highlights (.10¢) naec

The Wright Bros. Flyer (\$1.00) naec

The Wright Bros. (\$1.00) naec

Historical Photos #SIL-168 Rev. 11/58 (free) nasm

Drawings of Historic Aircraft

#SIL-122 Rev. 11/58 (free) nasm

Information Leaflets (free) nasm

The Flying Clippers (free) paw

Wright Bros. National Memorial (free) gpo

Historic Airplanes (free) ual

#### Unit II

Shape of Flight (free) sia

Unit III

Exam-O-Gram (free)	faa
Illustrated Flying Basics (\$1.50)	tha
Pre-Flight Facts (free)	ces
Student Pilot Guide (free)	faa
The Ten Most Frequently Asked Questions About Learning To Fly (free)	gtr
Plane Sense (free)	faa
Flight Instruments (\$1.95)	jep
Handbook For Theory Of Flight Kit (.50¢)	stas
Flight Training Guide (\$1.00)	gpo

TRAFFIC

## CHAPTER THREE

## Unit I Aircraft

## A. General Structure of an Airplane

## 1. Design Considerations

- a) Carrying Space
- b) Method of Lift
- c) Propulsion System
- d) Control System
- e) Navigational Devices
- f) Ground-Handling Apparatus

## 2. Wings

- a) Monoplane
  - (1) Low Wing
  - (2) Mid Wing
  - (3) High Wing
  - (4) Parasol Wing
- b) Biplane
  - (1) Negative or Positive Stagger
- c) Shape of Wing
  - (1) Rectangle
  - (2) Elliptical
  - (3) Swept Wing
  - (4) Delta
  - (5) Combinations

d) Structure

- (1) Full Cantilever
- (2) Externally Braced
- (3) Honeycomb
- (4) Fabric Covered
- (5) Metal Covered

e) Modifications

- (1) Flaps
- (2) Slots
- (3) Extending Leading Edges

3. Fuselage (hull)

- a) Truss
- b) Semi-Monocoque

4. Tail Assembly (empenage)

- a) Horizontal Stabilizer
- b) Vertical Stabilizer
- c) 'T' Tail

5. Landing Gear

- a) Conventional (tail wheel)
- b) Tri-Cycle (nose wheel)
- c) Fixed
- d) Retractable

ADVISORY



- e) Shock Absorbers
    - (1) Oleo Struts
    - (2) Shock Cords
    - (3) Spring Steel
  - f) Brakes
  - g) Pontoons
  - h) Skiis
6. Airplane Accessories
- a) De-Icing Equipment
  - b) Cabin Pressurization Equipment
7. Other Aircraft Types
- a) Helicopter
  - b) Gyroplane
  - c) Glider
  - d) Airship
    - (1) Rigid
    - (2) Semi-Rigid
  - e) Ornithopter
  - f) Convertoplane
  - g) STOL and VTOL
8. Construction Materials & Technique
- a) Metal
    - (1) Aluminum, Magnesium, Titanium
    - Copper, Steel Alloys

b) Wood

(1) Birch, Mahogany, Ash, Spruce

c) Joining

(1) Welding, Rivoting, Soldering,  
Brazing

(2) Nuts, Bolts, Screws, Special  
Fasteners

(3) Nails, Glue, Casein, Epoxy

(4) Safetying

d) Linen - Glass - Rubber - Asbestos

9. Aircraft Inspections

a) Annual (periodic)

b) 100 Hour

10. SST

70446 110040

## Unit II Aircraft Powerplants

### A. Desired Engine Requirements

1. Power to Weight Ratio
2. Reliability At All Speeds
3. Fuel, Oil, Power Ratio
4. Lack of Vibration
5. Ease of Maintenance

### B. Reciprocating Engines

#### 1. Types

- a) Inline
- b) Horizontally Opposed
- c) Radial
  - (1) Single--Double Row
- d) 'V'
- e) Rotary
- f) Other Arrangements

#### 2. Parts

- a) Block
- b) Cylinder - Piston - Rods - Valves
- c) Accessories

#### 3. Four-Stroke Cycle Principle

#### 4. Engine Systems

##### a) Fuel

- (1) Carburetor Requirements
- (2) Gasoline Requirements
  - (a) Octane
  - (b) Color
  - (c) Detonation
  - (d) Anti-Detonation

##### b) Induction

- (1) Supercharger
- (2) Turbo Charger

##### c) Lubrication

- (1) Dry--Wet Sump
- (2) Hopper Tank
- (3) Scavenger Pump

##### d) Ignition

- (1) Magneto
- (2) Distributor
- (3) Spark Plugs

#### C. Engine Placement

- 1. Tractor
- 2. Pusher
- 3. On Wings
- 4. On a Pylon

## 5. Number of Engines

## D. Propellers

## 1. Number of Blades

a) Two - Three - Four

## 2. Direction of Rotation

## 3. Pitch

a) Fixed

b) Controllable

c) Adjustable

d) Constant Speed

e) Feathering

f) Reversible

## E. Reaction Engines

## 1. Jet

a) Ram Jet

b) Pulse Jet

c) Turbo Jet

d) Turbo Prop

e) Turbo Fan

## 2. Rocket

## 3. Atomic

## F. Power Factors

## 1. Horse Power Formula

## 2. Thrust Formula

DRAWN BY

## Unit III Airplane Instruments

- A. Pitot - Static Tube
- B. Venturi Tube
- C. Bourdon Tube
- D. Flight Instruments
  - 1. Air Speed
  - 2. Altimeter
  - 3. Turn and Bank
  - 4. Vertical Speed
  - 5. Gyro Horizon
- E. Navigation Instruments
  - 1. Magnetic Compass
  - 2. Directional Gyro
- F. Engine Instruments
  - 1. Tachometer
    - a) Magnetic
    - b) Electric
  - 2. Oil Pressure
  - 3. Oil Temperature
  - 4. Cylinder Temperature
  - 5. Carburetor Air Temperature
  - 6. Manifold Pressure Gauge
  - 7. Fuel Flow Meter
  - 8. Exhaust Gas Temperature (EGT)

DRIVE TROUBLE

G. Other Instruments

1. Fuel Quantity Guage(s)
2. Outside Air Temperature (OAT)
3. Vacuum Guage

TPM/F TIDABV

## CHAPTER III ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

Unit I

Dept. of Commerce, (CAA). Aircraft Powerplant Handbook, Manual 107. Washington, D.C.: Govt. Printing Office, 1949.

United States Air Force. Aircraft Engineering For Pilots (51-42). Washington, D.C.: Dept. of the Air Force, 1952.

\_\_\_\_\_. Foundations of Air Power. Maxwell AFB, Alabama: Headquarters AFROTC, 1958.

\_\_\_\_\_. Fundamentals of Aerospace Weapons Systems. Maxwell AFB, Alabama: Headquarters AFROTC, 1961.

United States Navy. Introduction to Aircraft (NAVPERS 10303-A). Washington, D.C.: Navy Air Technical Training Command, 1951.

Brig. Gen. Neil D. van Sickle, USAF, Editor. Modern Airman-ship. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1961.

Charles Zweng. Aircraft and Engine Mechanics Manual. North Hollywood, California: Pan American Navigation Service, 1961.

Unit II

Robert B. Moyer. The First Airplane Diesel Engine: Packard Model DR-980 of 1928. Vol. 1 No. 2 of Smithsonian Annals of Flight. Washington, D.C.: Govt. Printing Office, 1964.

United States Navy. Aircraft Propellers. Washington, D.C.: Navy Air Technical Training Command, 1951.

\_\_\_\_\_. Fuel Systems. Washington, D.C.: Navy Air Training Command, 1951.

JUL 1 1964



Roy Wieden. Lightplane Engine Guide. New York City: Crown Publishers, 1965.

. . . also, information for this unit may be found in the sources listed for Unit I.

### Unit III

Dept. of Transportation (FAA). Instrument Handbook AC61-27. Washington, D.C.: Govt. Printing Office, 1966.

United States Air Force. Instrument Flying (51-37). Washington, D.C.: Dept. of the Air Force, 1965.

. . . also, information for this unit may be found in the sources listed for Unit I and Unit II.

## SELECTIONS FROM PERIODICALS

### Unit I

Richard S. Bach. "Wren 460," Flying (January, 1965), 36.

J. S. Butz, Jr. "Constant Attitude Aircraft," Flying (March, 1962), 22.

\_\_\_\_\_. "Philosophy of Design--Aero Commander," Flying (June, 1963), 28.

\_\_\_\_\_. "Philosophy of Design--Beech," Flying (April, 1963), 22.

\_\_\_\_\_. "Philosophy of Design--Cessna," Flying (May, 1963), 52.

\_\_\_\_\_. "Philosophy of Design--Mooney," Flying (August, 1963), 48.

\_\_\_\_\_. "Philosophy of Design--Piper," Flying (July, 1963), 36.

ADDITIONAL INFORMATION

- Editorial Staff. "Is Your Airplane Airworthy?" Pilot (April, 1965), 74.
- Editorial Staff. "Support Equipment and Accessories," Flying (November, 1962), 62.
- Editorial Staff. "The Big Squeeze," Skyline, XXIV (1966), 34.
- Editorial Staff. "Tires-Wheels-Brakes," Flying (January, 1963), 40.
- Editorial Staff. "XB-70A," Skyline, XXIII (1965), 3.
- Harry McDougall. "Avian Gyroplane," Flying (April, 1964), 44.
- E. V. Pickering. "A Closer Look At STOL," Pilot (October, 1965), 88.
- Bob Sand. "The Shape Of Things To Come," Private Pilot (December, 1964), 24.
- James M. Triggs. "Cessna Sky Hawks," Air Progress (Aug./Sept., 1963), 27.
- Richard B. Weeghman. "Focus On Design," Flying (November, 1962), 60.

## Unit II

- Robert Beatty. "Turbos, Pistons, or . . .," Flying (June, 1965), 52.
- J. S. Butz, Jr. "Engine Economy Through Regeneration," Flying (July, 1962), 44.
- \_\_\_\_\_. "C.E.--Pioneer In Turbines," Flying (February, 1963), 50.
- \_\_\_\_\_. "Powerplants," Flying (November, 1963), 33.
- Joe Diblin. "The Last Word In Power," Flying (February, 1967), 77.

- William F. Drucker. "Preventative Engine Maintenance," Pilot (February, 1963), 37.
- Editorial Staff. "The Ol' OX-5," Air Classics (Fall, 1965), 29.
- Editorial Staff. "What's Up Front--Exhaust Systems, I and II," F.A.A. News (November and December, 1967), 4 and 10.
- \_\_\_\_\_. "What's Up Front--Propellers, I and II," F.A.A. News (January and February, 1968), 6 and 6.
- James Gilbert. "It Began With A Bedstead," Flying (September, 1965), 50.
- Martin Haynes. "A New Look At Carburetor Ice," Private Pilot (October, 1966), 54.
- Al Hundree. "How Lean Is Too Lean?" Pilot (October, 1965), 38.
- Max Karant. "Turbochargers and Light Planes," Pilot (May, 1964), 112.
- Emil A. Malick. "Double Barreled Fuel Additive," Pilot (July, 1965), 66.
- C. Nicholas Pryor. "Why Variable Pitch Props?" Pilot (March, 1964), 30.
- Barry Schiff. "Flying The Prop," Private Pilot (November, 1967), 32.
- Leori Tex Smith. "Your Battery," F.A.A. News (November, 1966), 22.
- Robert T. Smith. "Overboost Means Trouble," Pilot (October, 1964), 72.
- Robert Weeghman. "Aviation Fuel," Flying (October, 1961), 44.
- \_\_\_\_\_. "The Power Behind The Bizjets," Flying (November, 1964), 26.

Unit III

Martin Haynes. "Brittain Turn Coordinator," Private Pilot (March, 1967), 68.

\_\_\_\_\_. "Exclusive Density Altimeter," Private Pilot (December, 1967), 50.

\_\_\_\_\_. "New Generation Of Instruments," Private Pilot (November, 1967), 23.

\_\_\_\_\_. "Strangers On The Panel," Private Pilot (October, 1967), 20.

Editorial Staff. "The Magnetic Compass," Airways (September, 1967), 58.

Don Francisco. "New Accuracy Standards For Altimeters," Airways (January, 1968), 24.

Cecil M. Hunter. "Airspeed, True or False," Pilot (January, 1963), 30.

Richard A. Noblett. "The New Direction," Flying (June, 1967), 78.

Steve Randall. "A.I.M.," Flying (March, 1962), 38.

Archie Trammell. "Al's Place," Flying (December, 1965), 45.

## FILM SUGGESTIONS

Unit I and Unit II

Aircraft Engines	TFI-136	faa
Aircraft Welding	MN-92	faa
Aviation Mechanic	FA-315	faa
Periodic Inspection--Airplane	OE-282	faa
Periodic Inspection--Engine	OE-283	faa

---

Servicing An Airplane	OE-279	faa
Aircraft Engines (Part 1)	U-1300	sui
Aircraft Propellers	U-1304	sui
The ABC Of Jet Propulsion		gm
The Gas Turbine		shl
The History Of The Helicopter	#30	iac
Transonic Flight	#59	lac
World On Wings		ces
Birth Of A Jet		dac
DC-8 Autopilot		dac
Prelude To Power		mqc
Speed and Heat		naai

Unit III

The Sensitive Altimeter--General Use TF 1-517 af

## ACTIVITIES AND PROJECTS

Unit I and Unit II

1. Assemble working plastic model of a radial aircraft engine.
2. Assemble working plastic model of a turbine aircraft engine.
3. Field Trips to: An airport maintenance shop; Des Moines Technical High School--Aviation Division; and Air National Guard maintenance shop (jets).
4. Reports on occupations in the maintenance areas.

Unit III

1. Demonstrations of the Venturi and Bernouli principles.
2. Obtain discarded aircraft instruments to dismantle in class.
3. Report and demonstrate the characteristics and function of a gyro and how it is used in an airplane.
4. Report on instrument development and repair areas.

## OCCUPATIONAL AREAS - CHAPTER III

Unit I and Unit II

Powerplant Technician	621.281
Powerplant Installer	621.381
Chief Mechanic	621.281
Engine Mechanic	621.281
Propeller Mechanic	600.381

. . . also see Chapter I, Occupational Areas, for:  
 Research & Design; Technicians; and all Plant Occupations  
 under Aerospace Manufacturing Industry and Skilled Occupa-  
 tions under Manufacturing Industry, Air Transportation, and  
 General Aviation.

Unit III

Aerodynamicist	002.081
Physicist	023.081 & .088
Aerodynamics Analyst	011.381
Design Draftsman	002.281
Tube Bender	709.884
Machinist	600.280 & .281
Assembly Inspector	806.381
Final Assembler	806.781
Instrument Mechanic	710.281

## SOURCES OF OCCUPATIONAL INFORMATION

Unit I, Unit II, and Unit III

International Association of Machinists and Aerospace  
Workers, 1300 Connecticut Ave., N.W., Washington, D.C.  
20030.

National Aviation Trades Association, 1346 Connecticut Ave.,  
N.W., Washington, D.C. 20036.

. . . also see "Sources," Chapter I.

## FREE OR INEXPENSIVE MATERIALS

Unit I

Documentary Note, #2 SE 210 Caravel (free)	afr
Progress Report--DC-9 August, 1967, #7 (free)	ual
The DC-8 Mainliner (free)	ual
Field Service Digest (Lockheed) (free)	lac
Aircraft Number 116 (.50¢)	naec
Jets (.50¢)	naec
U. S. Naval Aircraft Designations (free)	nan
The Story of Helicopters (free)	uac
The X-15 Research Airplane (free)	nasa
Boing Documentary Note (free)	afr
Air Age Information Folder (free)	bac
Illustrated Brochure, Beech Airplanes (free)	bac
Teacher's Packet of Information (free)	ces
Lear Jet (free)	ljc

Lockheed Pathways To The Stars (free)	lag
---------------------------------------	-----

Unit II

Jet Facts (free)	ge
------------------	----

Do's and Dont's (free)	cmc
------------------------	-----

Power To Set World Records	aly
----------------------------	-----

Sky Parade (free)	aly
-------------------	-----

The Lycoming "Flyer" (free)	aly
-----------------------------	-----

Engine Specification Sheets (free)	aly
------------------------------------	-----

The Aviation Spark Plus (free)	csp
--------------------------------	-----

All About America's Favorite Aviation	
---------------------------------------	--

Spark Plus (free)	csp
-------------------	-----

Precise Flight Power (free)	cmc
-----------------------------	-----

The Story Of The Turbine (free)	ge
---------------------------------	----

Flight Power From Allison (free)	all
----------------------------------	-----

Turboshaft Power (free)	all
-------------------------	-----

Hercules Turboprop Power (free)	all
---------------------------------	-----

Propjet Convair (free)	all
------------------------	-----

Test Of A Regenerative Turboprop	
----------------------------------	--

Aircraft Engine (free)	sae
------------------------	-----

Approach, Jan., 1966 (free)	nasr
-----------------------------	------

Engineered For Power (free)	sol
-----------------------------	-----

Aeronautical Powerplants (free)	aia
---------------------------------	-----



0-58

Unit III

The Gyroscope Through The Ages (free)

sgc

Gyros (free)

lsi

E.G.T., Specification Sheets (free)

alc

## CHAPTER FOUR

## Unit I Air Navigation

## A. Forms of Navigation

## 1. Pilotage

- a) Courseline
- b) Check Points

## 2. Dead Reckoning

- a) True Course
  - (1) True North
- b) True Heading
- c) Magnetic Course
  - (1) Magnetic North
  - (2) Variation
- d) Compass Course
  - (1) Deviation
- e) Wind Correction Angle
- f) Indicated Air Speed
- g) True Air Speed
- h) Indicated Altitude
- i) True Altitude
- j) Track

### 3. Radio

#### a) Aids

- (1) Federal Airlines
- (2) Omni Range (VOR)
- (3) Distance Measuring Eqpt. (DME)
- (4) Transponder
- (5) Radio Beacons
- (6) Automatic Direction Finder (ADF)
- (7) Coupled Auto Pilot
- (8) Instrument Landing Systems (ILS)
  - (a) Localizer
  - (b) Glide Slope
  - (c) Marker Beacons
  - (d) Radar
    - i) Precision
    - ii) Surveillance
  - (e) Back Course

#### b) VOR Radio Equipment

- (1) Frequency Selector
- (2) Omni Bearing Selector (OBS)
- (3) Course Needle
- (4) Ambiguity Meter (To - From)
- (5) VOR Cross Fixing

4. Celestial

a) Equipment

(1) Sextant

(2) Astrolobe

(3) Chronograph

(4) Air Almanac

b) Electronic

(1) Doppler

(2) Astro-Tracker

5. Charts

a) Local

b) Sectional

c) World (WAC)

d) Planning

e) Radio Facility

6. Other Equipment

a) E 6B Computer

b) Plotter

## Unit II Meteorology

### A. The Atmosphere

1. Troposphere
2. Tropopause
3. Stratosphere
4. Ionosphere
5. Outer Space

### B. Elements of Meteorology

#### 1. Temperature

- a) Standard Temperature
- b) Convection
- c) Conduction
- d) Radiation

#### 2. Pressure

- a) Standard Pressure
- b) Units of Measurement
  - (1) Lbs. Per Sq. Inch
  - (2) Inches of Mercury
  - (3) Millibars

#### 3. Moisture

- a) Relative Humidity
- b) Dew Point
- c) Precipitation

## 4. Clouds

- a) High Level
- b) Middle Level
- c) Low Level
- d) Vertical Development
- e) Cumulus
- f) Stratus

## 5. Circulation

- a) Coriolis Force
- b) Doldrums
- c) Trade Winds
- d) Westerlies - Easterlies

## 6. Air Masses

- a) Polars
- b) Tropicals
- c) Maritimes
- d) Continentals

## 7. Fronts

- a) Cold Front
- b) Warm Front
- c) Occluded Front
- d) Stationary Front

## C. Importance to Aviation

### 1. Ceiling

- a) Effective Pilot Ceiling
- b) Reported Ceiling

### 2. Visibility

- a) Prevailing Visibility
- b) Runway Visibility
- c) Runway Visual Range

### 3. Turbulence

- a) Convection Currents
- b) Obstructions to Windflow
- c) Wind Shear
- d) Mountain Wave
- e) Clear Air Turbulence
- f) Wake Turbulence

### 4. Icing

- a) Forms
  - (1) Clear Ice
  - (2) Rime Ice
  - (3) Frost
- b) Effects in Flight

## D. Weather Information

1. Sequence Reports
  - a) Sequence Symbols
2. Area Forecasts
3. Terminal Forecasts
4. Winds Aloft Reports
5. Maps (Charts)
  - a) Daily
  - b) Hourly
    - (1) Map Station Models
    - (2) Map Symbols
6. Automatic Transcribed Weather Service ATWS)
7. Pilot Reports (PIREPS)
8. Severe Weather Warnings
  - a) SIGMETS
  - b) AIRMETS



## CHAPTER IV ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

Unit I

Arthur A. Ageton, USN (ret.). Celestial Navigation. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1961.

Department of Transportation, Federal Aviation Agency, Flight Standards Service. Private Pilot's Handbook of Aeronautical Knowledge (AC61-23). Washington, D.C.: Government Printing Office, 1965.

Thoburn C. Lyon. Practical Air Navigation. Annapolis, Maryland: Weems System of Navigation, Inc., 1960.

United States Air Force. Air Navigation (51-40). Washington, D.C.: Dept. of Air Force, 1954.

Brig. Gen. Neil D. van Sickle, USAF, Editor. Modern Airmanship. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1961.

Allan Zweng. Practical Manual of the E6-B Computer. North Hollywood, California: Pan American Navigation Service, 1960.

Charles Zweng and John Dohm. Flying The Omnirange. North Hollywood, California: Pan American Navigation Service, 1960.

Unit II

Louis J. Battan. The Nature of Violent Storms. Garden City, New York: Doubleday & Co., Inc., 1961.

Department of Commerce, Weather Bureau. Manual of Cloud Forms and Codes for States of the Sky. Washington, D.C.: Govt. Printing Office, 1956.

Department of Transportation, Federal Aviation Agency and Department of Commerce, Weather Bureau. Aviation Weather. Washington, D.C.: Govt. Printing Office, 1965.

James G. Edinger. Watching For The Wind. Garden City, New York: Doubleday & Co., Inc., 1961.

Charles G. Halpine, USN (ret.). A Pilot's Meteorology. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1963.

Harold E. Mehrens. Navigation and the Weather. Maxwell AFB, Alabama: Civil Air Patrol, 1963.

### SELECTIONS FROM PERIODICALS

#### Unit I

Jack LeBaron. "DF Steer," Flying (August, 1962), 56.

Frank J. Clifford. "Lost? No Sweat," FAA News (January, 1967), 3.

Editorial Staff. "New Sectional Charts," FAA News (September, 1967), 4.

Alice Fuchs. "Navigation By Landfall," Flying (October, 1961), 66.

Barry Schiff. "Why Not Really Learn To Navigate?" Pilot (June, 1963), 40.

Richard B. Weeghman. "Charting With The Future," Flying (January, 1964), 42.

\_\_\_\_\_. "Navigate By Doppler," Flying (June, 1963), 32.

\_\_\_\_\_. "Need Or Nuisance," Flying (October, 1964), 56.

#### Unit II

Fred C. Bates. "Storm Warning," Flying (June, 1967), 94.

R. Blodget. "The Big Picture," Flying (September, 1967), 53.

J. S. Butz, Jr. "Shock Waves--Invisible Hazzard To Light Planes," Flying (December, 1961), 28.

- Don Downie. "Ice Is For Drinks," Private Pilot (December-January, 1966), 56.
- Ted Durosco. "Low Level Jet Stream," Flying (October, 1962), 50.
- Henry T. Harrison. "Weather Signposts," Flying (November, 1965), 49.
- Betty Hicks. "Flying The Mountain Wave," Flying (August, 1965), 68.
- Jack LeBaron. "Clear Air Turbulence," Flying (October, 1961), 60.
- C. Pfeiffer Trowbridge. "Weather and Whether . . .," Private Pilot (February, 1968), 50.
- H. A. Shanklin. "Know Your Weather," Flying (June, 1963), 50.
- Barbara Witchell Tully. "Fronts--Clouds--Visibility," Pilot (March, 1963), 34.
- \_\_\_\_\_. "The Weather And Human Factors," Pilot (February, 1963), 30.
- Harry M. Zubkoff. "Clouds: Their Message To Pilots," Pilot (April, 1964), 56.

#### FILM SUGGESTIONS

##### Unit I

Celestial Navigation--The Earth	U-1310	sui
Celestial Navigation	U-1311	sui
Give Me A Second Station	SFP-411	af
Highways In The Sky	SFP-386	af
Long Range Navigation	TF-5228	af

Navigation	MN-83G	faa
Omni Bearing Distance Navigation	#38	iac
Primary Pilot Navigation	TF-4990	af
Radio Compass Equipment (1 & 2)	TF-4989	af
Where Am I?	SFP-1128	af
Wind And The Navigator--Wind Theory	TF-5206a	af

Unit II

Air Masses And Fronts	TFI-4481	faa
Flight Decision	#25	iac
Modern Weather Theory--Atmospherics	U-1307	sui
Modern Weather Theory--Circulation	U-1306	sui
Origins of Weather	#62	iac
Radar Refraction And Weather	TF-1-5079a	af
The Cold Front	#103	faa
The Warm Front	#104	faa
The Weather	U-993	sui
Thunderstorms	#24	iac
Unchained Goddess	SWB I & II	faa
Weather Research	U-4151	sui
Weather--Friend or Foe	AFSR-129	af
Your Air Weather Service	SFP-1037	af

## ACTIVITIES AND PROJECTS

Unit I

1. Work with E6-B Computer and Mark II Plotter to learn how these instruments are used by a pilot or navigator.
2. Reports on various types of aeronautical charts.
3. Study the use of a sextant and how it is used in celestial navigation.
4. Field trip to FAA VOR site for orientation on how Omni operates.
5. Report on occupations and vocations in the navigation area.

Unit II

1. Obtain, or construct, weather recording instruments and make daily observations.
2. Observe daily cloud formations, wind directions, and estimate cloud cover and ceiling.
3. Study weather bureau maps and reports to learn symbols and coding and to make local forecasts.
4. Field trip to Weather Bureau, Des Moines Municipal Airport.
5. Report on careers in meteorology.

## OCCUPATIONAL AREAS - CHAPTER IV

Unit I

Astronomer	021.088
Cartographer	017.281
Electronics Engineer	003.081

Electronic Technician	003.181
Navigator	196.188

Unit II

Mathematician	020.088
Physicist	023.081 & .088
Meteorologist	025.088

## SOURCES OF OCCUPATIONAL INFORMATION

Unit I

Aircraft Electronics Ass'n., Inc., 6310 Gen. Twining Ave.,  
Airgate Station, Sarasota, Florida 33580.

American Society For Engineering Education, 1346 Connecticut  
Ave., N.W., Washington, D.C. 20036.

Air Line Navigators Council, TWU-CIO, 9574 Lake Shore Blvd.,  
Seattle, Washington.

. . . also see "Sources," Chapter I.

Unit II

American Meteorological Society, 45 Beacon St., Boston,  
Massachusetts 02108.

Department of Commerce, Weather Bureau, Washington, D.C.

. . . also see "Sources," Chapter I.

## FREE OR INEXPENSIVE MATERIALS

Unit I

You And Your VOR (free)	faa
-------------------------	-----

Map Projections For Modern Charting (free)	dpc
--	-----

VOR & DME, Dead Reckoning, Area Charts, ADF &  
 L/MF, IFR Approaches (plastic references  
 @ \$1.95 each)

jep

You And Your Radio (free)

faa

Flight--The Story Of Electronic Navigation (free)

faa

## Unit II

What's The Weather? (free)

afr

Aviation Weather Series (18 pamphlets @ .05¢ ea.)

gpo

Flying And Weather (.10¢)

naec

Field Service Digest #48 (free)

lac

Key To Aviation Weather Forecasts (.05¢)

gpo

(Also at local Weather Bureau-free)

Pilots Weather (free)

faa

How To Forecast The Weather (free)

iac

Cloud Chart (free)

iac

Weather Bureau Activities (free)

dpc

The Upper Atmosphere--chart (free)

gar

Air Pressure--chart (free)

gar

## CHAPTER FIVE

## Unit I Air Traffic Control &amp; Communications

## A. Air Terminal Problems

1. Local Traffic
2. Airlines
3. Enroute Traffic
  - a) Air Route Traffic Control Center (ARTC)
4. High Speed Aircraft
5. Low Speed Aircraft

## B. Aircraft Communications

1. Radio Telephone Procedures
  - a) Phonetic Alphabet
  - b) Statement of Time
  - c) Procedure Words and Phrases

## C. Control Tower

1. Radio Frequencies--Transmitting-Receiving
2. Responsibilities
  - a) Landing & Departing Aircraft
  - b) Aircraft Entering Traffic Pattern
  - c) Landing Sequencing
  - d) Ground Control (Taxiing)
  - e) Advisory Information (Weather)



D. Non Control Tower Airports

1. Flight Service Station Advisories
2. Local Airport Advisories (UNICOM)

E. Air Traffic Service

1. Controlled Airspace

- a) Control Zone
- b) Control Area
- c) Air Lanes
- d) Visual Flight Regulations (VFR)
- e) Instrument Flight Regulations (IFR)

2. Flight Plans

- a) Visual Flight Plans (VFR)
- b) Instrument Flight Plans (IFR)

3. Air Route Traffic Control Center (ARTC)

- a) IFR Flight Plans
  - (1) Flight Level
  - (2) Airplane Separation
- b) Towers
  - (1) Approach--Departure Control
  - (2) Radar Service
- c) Flight Service Stations
  - (1) Preflight Weather
  - (2) Inflight Weather
  - (3) Local and Area Weather

## Unit II The Department of Transportation--

## Federal Aviation Agency (FAA)

## A. Government Regulations

1. C.A.A. Acts of 1938 and 1940
2. Model Aviation Act of 1944
3. F.A.A. Act of 1958
4. International Civil Aviation Org. (ICAO)

## B. Functions of the F.A.A.

1. Civil Aeronautics Board (CAB)
2. Controlling Air Traffic
3. Provide Ground Facilities
4. Determine Pilot and Aircraft  
Qualifications and Standards
5. Research and Development

## C. Organization

1. Administrator
2. Deputy Administrator
3. Associate Administrators

## D. Federal Aviation Regulations

1. Subchapter A Definitions
  - a) Part 1--Definitions and Abbreviations
2. Subchapter B Procedural Rules
  - a) Part 11--General Rule-Making Procedures
  - b) Part 13--Enforcement Procedures

### 3. Subchapter C Aircraft

- a) Part 21--Aircraft Certification
- b) Part 23--Airworthiness Standards, Normal, Utility, and Aerobatic
- c) Part 25--Airworthiness Standards, Transport Category
- d) Part 27--Airworthiness Standards, Rotorcraft
- e) Part 29--Airworthiness Standards, Transport Rotorcraft
- f) Part 33--Airworthiness Standards, Engines
- g) Part 35--Airworthiness Standards, Propellers
- h) Part 37--Technical Standard Orders, Materials, Parts, Appliances
- i) Part 39--Airworthiness Directives
- j) Part 41--Airworthiness Operating and Equipment Standards
- k) Part 43--Maintenance and Alteration
- l) Part 45--Identification and Registration

### 4. Subchapter D Airmen

- a) Part 61--Certification, Pilots, Instructors
- b) Part 63--Flight Crew Other Than Pilots
- c) Part 65--Certification Other Than Flight Crew
- d) Part 67--Medical Standards and Certification

5. Subchapter E Airspace

- a) Part 71--Federal Airways, Controlled Airspace, Reporting Points
- b) Part 73--Special Use Airspace
- c) Part 75--Establishment of Jet Routes
- d) Part 77--Construction or Alteration Affecting Airspace

6. Subchapter F Air Traffic and General Operating Rules

- a) Part 91--General Operating and Flight Rules
- b) Part 93--Special Air Traffic Rules and Airport Traffic Patterns
- c) Part 95--IFR Altitudes
- d) Part 97--Standard Instrument Approaches
- e) Part 99--Security Control of Air Traffic
- f) Part 103--Transportation of Dangerous Articles and Magnetized Materials
- g) Part 105--Parachute Jumping

7. Subchapter H Schools and Other Certificated Agencies

- a) Part 141--Pilot Schools
- b) Part 143--Ground Instructors
- c) Part 145--Repair Stations
- d) Part 147--Mechanic Schools
- e) Part 149--Parachute Lofts

8. Subchapter I Airports

- a) Part 151--Federal Aid to Airports
- b) Part 153--Acquisition of U.S. Land for Public Airports
- c) Part 155--Release of Airport Property From Surplus Property Disposal Regulations
- d) Part 157--Construction, Alteration, Deactivation of Airports
- e) Part 159--National Capital Airports
- f) Part 161--Cold Bay, Alaska Airport
- g) Part 163--Canton Island, Airport
- h) Part 165--Wake Island, Airport

9. Subchapter K Administrative Regulations

- a) Part 181--Seal
- b) Part 183--Representatives of The Administrator
- c) Part 185--Testimony at Legal Proceedings
- d) Part 187--Copying and Certifying Fees For FAA Records
- e) Part 189--Use of FAA Communications

E. Pilot Regulations

- 1. Age For Rating
- 2. Physical Examination
- 3. Written Knowledge
- 4. Flight Instruction

5. Solo Flight(s)

6. Practical Examination (Check Ride)

F. Air Traffic Rules

1. Controlled Airspace

2. Non-Controlled Airspace

## CHAPTER V ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

Unit I

James V. Bernardo. Aviation In The Modern World. New York City: E. P. Dutton & Co., Inc., 1962.

Department of Transportation, Federal Aviation Agency. Pilot's Radio Handbook. Washington, D.C.: Govt. Printing Office, 1962.

Editorial Staff, Gale Research. Airports, Airways, and Electronics. Detroit: Book Tower, 1967.

Unit II

James V. Bernardo. Aviation In The Modern World. New York City: E. P. Dutton & Co., Inc., 1962.

Arnold E. Briddon, FAA Historian. FAA Historical Fact Book--A Chronology, 1926-1963. Washington, D.C.: Govt. Printing Office, 1963.

Department of Transportation, Federal Aviation Agency. The Federal Aviation Agency. Washington, D.C.: Govt. Printing Office, 1966.

Brig. Gen. Neil D. van Sickle, USAF, Editor. Modern Airman'ship. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1961.

## SELECTIONS FROM PERIODICALS

Unit I

George A. W. Boehm. "Airports: Blueprint For Tomorrow," Air Facts (September, 1966), 44.

Peter M. Bowers. "Airport Traffic Patterns," Air Progress (March, 1968), 34.

\_\_\_\_\_. "Entering The Pattern," Air Progress (April, 1968), 32.

George Carroll. "Sky Cop," Flying (November, 1964), 56.

V. M. Draper. "Airports--The Twin Cities Way," Flying (June, 1967), 82.

Editorial Staff. "Midair Collisions," Pilot (August, 1964), 70.

Editorial Staff. "New Airport Runway Standards," FAA News (November, 1967), 13.

\_\_\_\_\_. "Time Is Money--Airport Delays," FAA News (October, 1966), 12.

Paul Garrison. "Don't Let The Big Ones Scare You," Private Pilot (October, 1967), 64.

Robert Gingles. "Radar and VFR Flying," Pilot (June, 1963), 38.

Robert W. Harrison. "Your Cheapest Insurance," Flying (December, 1962), 44.

Arthur Hood. "GCA Is For You--Use It," Private Pilot (May, 1968), 26.

Roy C. Jones. "The Traffic Controllers Bible," Pilot (March, 1967), 53.

William J. Kendall. "New Concept In Air Traffic Control," Flying (December, 1963), 44.

Robert E. Kyle. "Positive Control and General Aviation," Flying (December, 1963), 88.

Robert Parrish. "Another Mid-Air Tragedy," Pilot (September, 1967), 25.

John Pennington. "All-Weather Radar Vectoring," Flying (September, 1962), 40.

Lawrence Reithmaier. "Our Amazing Airways System," Flying (January, 1962), 58.

A. Sanfelici. "Big-City Airport," Flying (March, 1964), 26.



Robert Vehm. "A Controller Looks At General Aviation," Airways (February, 1968), 43.

Gene Wilson. "Do You Read Me?" Air Facts (June, 1966), 44.

John Yodice. "Flight Rules For VFR Pilots," Pilot (October, 1966), 106.

## Unit II

Editorial Staff. "An FAA Report," Airways (May, 1968), 57.

Editorial Staff. "FAA's Spy In The Sky," Pilot (June, 1965), 30.

Joseph Early. "New FAA Proposals," Airways (April, 1968), 26.

James Gilbert. "The FAI Explained," Flying (December, 1966), 64.

Frank A. Tinker. "Who Owns The Air?" Flying (January, 1962), 42.

John S. Yodice and Len Thornton. "FAA Enforcement Procedures," Pilot (November, 1965), 92.

## FILM SUGGESTIONS

### Unit I

A Traveler Meets Air Traffic Control	#102	faa
Flying Follies (Parts 1, 2, and 3)	TF 1-4038	af
Ground Control Approach	#35	iac
Ground Safety On The Flight Line	TF 1-5047b	af
ILS, Instrument Landing System	TF 1-5016	af
Operation Zero, Zero	FR 35	af
Private Pilot	#211	faa

The Pilot And Air Traffic Control	#102	faa
What's My Traffic?	#201	faa

## Unit II

Flight	#117	faa
Path From The Sky	#119	faa
In These Hands	#123	faa

## ACTIVITIES AND PROJECTS

### Unit I

1. Report on air communications procedures.
2. A simulated conversation between a plane in flight and a tower controller.
3. Field trip to Des Moines Municipal Airport Control Tower, Radar Room, and FAA Flight Service Station.
4. Report on Careers in Air Traffic Control.

### Unit II

1. Obtain a speaker from the FAA to talk on the function of the FAA.
2. Obtain a speaker from the Iowa Aeronautics Commission to speak on the function of the IAC.
3. Report on Federal Air Regulations.
4. Report on careers with the FAA and CAB.

## OCCUPATIONAL AREAS - CHAPTER V

Unit I and Unit II

The Federal Aviation Agency, Department of Transportation, employs nearly 40,000 people. The job titles and requirements are much the same as found in the Air Transport, General Aviation, and Electronic areas of the aerospace industries. One of the many, and principle, functions of the FAA is the certification of airworthiness capabilities of aircraft design, production, and utilization. Engineering and trades people are used for consultation and inspection in the plant and in the field to ascertain that design specifications, production methods, and modifications or repairs meet or exceed specified standards. The CAB (Civil Aeronautics Board) besides regulating commercial air carriers also is entrusted with the duty of examining all airplane accidents to determine the cause. The CAB personnel are experts in various areas of airplane construction such as control systems, hydraulic systems, metal and structural work, etc.

Air Traffic Control is the largest department of the FAA and the following job titles come under this area:

Tower Controllers	193.168
Approach Controllers	193.168
Departure Controllers	193.168
Ground Controllers	198.168
Air Route Center Controllers	193.168

In addition to the aforementioned titles the following selected job titles will give some indication to the diversity of occupations in the FAA.

Information & Editorial	132.038
Safety Management	168.284
Urban Planning	054.088
Chaplain	120.108
Security Administration	189.168
Social Science	054.088
Economist	050.088
Historian	052.088
Psychologist	045.088
General Anthropology	055.088
Composing Machine Operator	650.582
Computer Systems Adm.	020.168
Computer Programming	020.188
Cryptographic Eqpt. Operator	208.588
Communications Specialist	822.281
Biologist	041.081
Pharmacologist	041.081
Horticulturist	041.081
Accountant	160.188
Nurse	075.478
Medical Technologist	078.168 & .381
Electrocardiograph Tech.	078.368
Dental Officer	072.108
Industrial Hygienist	078.368
Cartographer	017.281
Engineering Draftsman	002.281
Electronic Engineer	003.381
Aerospace Engineer	002.281
Attorney	110.108
Illustrator	141.081
Photographer	143.062 & .382
Audio Visual Production	099.168
Realty Acquisition	186.118
Physicist	023.081 & .088
Chemist	022.081
Meteorologist	025.088
Navigational Specialist	196.188
Mathematician	020.088

Aviation Safety Officer	620.281
	621.281 & .381 & .781
	693.281
	769.281
	801.381
	825.381
	862.381
Traffic Management	019.188
Aircraft Operations (Pilot)	196.283

Supplementing this list are many administrative titles which are higher levels of the titles listed. There are also the usual clerical titles found in office work.

#### SOURCES OF OCCUPATIONAL INFORMATION

Air Traffic Conference of America, 1000 Connecticut Ave., N.W., Washington, D.C. 20036.

Air Traffic Control Association, Suite 409, ARBA Bldg., 525 School St., S.W., Washington, D.C. 20024.

Aircraft Mechanics Fraternal Association, 134-02 Jamaica Ave., Jamaica, New York 11418.

Airlines Communications Administrative Council, % Aeronautical Radio, Inc., 2551 Riva Rd., Annapolis, Maryland 21401.

Airlines Medical Directors Association, % George F. Catlett, M.D., United Air Lines, Inc., John F. Kennedy International Airport, Jamaica, New York 11430.

Airport Operators Council International, Inc., 1700 K St., N.W., Washington, D.C. 20006.

American Association of Airport Executives, P.O. Box 767, Greater Wilmington Airport, Wilmington, Delaware.

. . . also see "Sources," Chapter I.

## FREE OR INEXPENSIVE MATERIALS

Unit I

Some ABC's Of Air Traffic Management (free)	faa
Glossary Of Air Traffic Control Terms (free)	faa
The Control Tower (free)	faa
Flight (free)	faa
General Description--ARTS-Radar Traffic Control System (free)	faa
In These Hands (free)	faa
The Story of Safety In The Sky (free)	faa
Air Traffic Patterns and Community Characteristics (.35¢)	gpo

Unit II

A Picture Story of The FAA In Action For You (free)	faa
FAA--What It Is-What It Does (free)	faa
FAA Glossary (free)	faa
The Flight Service Station (free)	faa
The Federal Aviation Agency (.25¢)	faa
Federal Air Regulations (write for price list)	gpo

## CHAPTER SIX

## Unit I Space Travel

## A. The Solar System

1. The Sun
2. The Planets
3. Other Bodies
  - a) Asteroids, Comets, Meteorites

## B. Earth's Atmosphere

1. Divisions Of Atmosphere and Space

## C. History of Rockets

1. China
2. Europe
3. Asia
4. United States
5. Dr. Robert Goddard
6. Herman Oberth
7. Walter Hohmann
8. Walter Dornberger
9. Werner Von Braun

## D. Origins of Astronautics

## E. The Motion of Bodies in Space

1. Newton's Laws
2. The Laws of Planetary Motion

3. Motion

4. Perturbations

5. Free Fall

F. The Rocket

1. Rocket Operation

2. Rockets and the Laws of Motion

3. Rockets--Jets

4. Rockets--Missiles

G. Space Problems

1. Propulsion Systems

a) Solid Fuel

b) Liquid Fuel

c) Nuclear Power

d) Photon Power

e) Ion Power

f) Plasma Engine

g) Propellant Problems

h) Engine Power Ratings

(1) Thrust

(2) Specific Impulse

(3) Exhaust Velocity

(4) Mass Ratio



2. Accurate Guidance Systems

- a) Pre-Set
- b) Command
- c) Target Seeking
- d) Inertial
- e) Celestial

3. Spacecraft Design

- a) Aerodynamically
- b) Ballistically
- c) Strength

4. Environmental

- a) Acceleration
- b) Weightlessness
- c) Physical Needs
- d) Radiation

5. Reentry

- a) Deceleration
- b) Heat--Cooling
- c) Glide--Parachute Braking

## Unit II Unmanned Space Exploration

### A. Purposes

1. Quest For Knowledge
2. Peaceful Uses
  - a) Joint International Ventures
    - (1) Geophysical Year
3. National Security--Prestige

### B. Current Activities

1. Mariner
2. Surveyor
3. "Fly-Bys"

Unit III Manned Exploration

A. Projects

1. X-15 Rocket Plane
2. Project Mercury
3. Project Gemini
4. Project Apollo

B. Peaceful Application of Space Research

1. Communications
2. Weather
3. Consumer Goods

## CHAPTER VI ENRICHMENT AND TEACHER AIDS

## SELECTED READINGS

Unit I, Unit II, and Unit III

- Erik Berghust. Reaching For The Stars. New York City: Doubleday & Co., 1960.
- Theodore Berland. The Scientific Life. New York City: Coward-McCann, Inc., 1962.
- Martin Caidin and Grace Caidin. Aviation and Space Medicine. New York City: E. P. Dutton & Co., 1962.
- Courtland Canby. A History of Rockets and Space. New York City: Hawthorne Books, 1963.
- John M. Cavanaugh. Introduction to Space Age Astronomy. Washington, D.C.: Educational Services, 1960.
- James A. Coleman. Modern Theories of The Universe. New York City: New American Library, 1963.
- Eugene Emme. The History of Rocket Travel. Fallbrook, California: Aero Publishers, Inc., 1966.
- Editors of Fortune. The Space Industry--America's Newest Giant. Englewood Cliffs, New Jersey: Prentice Hall, 1962.
- General Dynamics Aeronautics. Space Primer. San Diego, California: General Dynamics Corporation, 1961.
- Craig Kuentz. Understanding Rockets and Their Propulsion. Fallbrook, California: Aero Publishers, Inc., 1966.
- Willy Ley. Satellites, Rockets, and Outer Space. New York City: Signet--New American Library, 1962.
- Donald M. Michael and others. Proposed Studies on The Implementation of Peaceful Space Activity. Washington, D.C.: Brookings Institute, 1961.
- Lloyd Mutz. This Is Outer Space. New York City: Anchor House, 1960.

Parvin. Inertial Navigation. Fallbrook, California: Aero Publishers, Inc., 1965.

A. Oparin and V. Fesenkov. Life In The Universe. New York City: Twayne Publishers, 1961.

### SELECTIONS FROM PERIODICALS

The following periodicals are devoted to current topics on space manufacturing, space technology, and space exploration:

Aviation Week and Space Technology (weekly)

NASA Notes (monthly)

Space Digest (monthly)

. . . company journals of member companies of the Aerospace Industries Association contain much information and may be obtained and the writer's name placed on the mailing list when so requested.

### FILM SUGGESTIONS

Unit I, Unit II, and Unit III

America In Space	HQ-103	nasa
Aviation Medicine	U-4164	sui
Background of Rocketry	288	net
Beating The Heat	HQ-1	nasa
Eternal Day--Eternal Night	1366	net

Exobiological Safety	HQa-65	nasa
How Did Life Begin?	HQ-32	nasa
Inertial Guidance	EM-1178	auto
Life On Other Planets	HQ-34	nasa
Life On Other Worlds	1369	net
Man In Space	#51	iac
Mastery Of Space	#16	iac
Principles of Inertial Navigation	EM-1389	auto
Project Apollo--Manned Flight		
To The Moon	HQ-88	nasa
Rocket Club	SFP-674	af
Space For the Benefit Of Mankind	HQk-93	nasa
Space Guidance and Control	TF 1-5294	af
Space Navigation	TF 1-5295	af
Survey Of Astronautics	TF 1-5292	af
The Unseen Burden	1362	net
The Airman's World--Man In Flight	SFP-1121h	af
The Airman's World--Aerospace Medicine	SFP-1121e	af

### ACTIVITIES AND PROJECTS

#### Unit I, Unit II, and Unit III

1. Obtain a speaker from the McDonald Corp, St. Louis, Missouri, builder of the Mercury and Gemini capsules.
2. Obtain a speaker from the U. S. Air Force to talk on "Space And The National Security."

3. Build and launch model rockets of one, two, or three stages and compute altitude and trajectory.
4. Reports on various guidance systems used in rockets and missiles.
5. Field trips to N. W. Bell telephone Co. to observe operation of micro-wave equipment, Collins Radio in Cedar Rapids, Iowa, and Bendix Corp., Instruments and Life Support Division, Davenport, Iowa.
6. Reports on the career fields in aerospace industries and aerospace support industries.

## OCCUPATIONAL AREAS - CHAPTER VI

### Unit I, Unit II, and Unit III

Degreed and non-degreed occupations in spacecraft and missile design, development, and manufacturing are essentially those listed under "Occupational Areas," in Chapter I. However, scientists and technologists employed by the National Aeronautics and Space Administration (NASA) find themselves in a somewhat unique situation. Job titles in NASA reflect the highly specialized nature of aerospace technology. It is next to impossible for NASA to obtain college, or technical school, trained graduates to fill specialty positions as the need for these positions change as rapidly as the frontiers of aerospace technology change. Thus it would not be practical for colleges and technical schools to establish curriculums for these specialties. NASA personnel bulletins point out personnel are selected on the basis of solid backgrounds

in the fundamental sciences or technical areas. The individual is then "fitted" to a specialized position within their background training.

NASA science and technical areas and specialized positions are listed below:

#### Space Sciences

- Aeronomy
- Ionospherics
- Field and Particles
- Stellar Studies
- Lunar and Planetary Studies
- Meteoroid Studies
- Solar Studies

#### Fluid and Flight Mechanics

- Flight Mechanics
- Control and Guidance Systems
- Fluid Mechanics
- Magnetofluidynamics
- Aerostructural Dynamics
- Flight Vehicle Acoustics
- Heat Transfer
- Stability, Control Performance
- Flight Vehicle Atmosphere Environment
- Basic Properties of Gases

#### Materials and Structures

- Materials
- Structural Materials
- Aerospace Metals
- Basic Properties of Materials
- Aerospace Polymers
- Refractory Compounds
- Friction and Lubrication
- Structural Mechanics
- Flight Structures



Propulsion Systems

Liquid Propulsion Systems  
Solid Propulsion Systems  
Electrical Propulsion and Power  
Direct Energy Conversion  
Nuclear Energy Processes  
Nuclear Propulsion and Power  
Chemical Energy Processes  
Internal Flow Dynamics

Flight Systems

Reliability  
Flight Systems Test  
Experimental Manufacturing Techniques  
Quality Assurance  
Electrical Systems  
Manned Space Flight Systems

Measurement and Instrumentation Systems

Sensors and Transducers  
Space Optics  
Measurement Standards and Calibration  
Control Systems  
Tracking and Telemetry Systems  
Antennas  
Telemetry Systems  
Tracking Systems  
Tele-Communications  
Electronics of Materials

Data Systems

Data Analysis  
Data Equipment  
Theoretical Simulation

Experimental Facilities and Equipment

Launch and Flight Operations  
Experimental Tooling and Equipment  
Fluid and Flow Systems

Electrical Experimental Equipment  
Experimental Facilities Techniques  
Nuclear Experimental Techniques

Management

Program Management  
Project Management  
Technical Management  
Technology Utilization

Research Piloting

Spacecraft (Astronaut)  
Sub-Space (X-15)

Life Studies

Biochemical Processes  
Psychological Studies  
Plant Studies  
Physiological Studies  
Molecular Biodynamics  
Radiobiological Studies  
Neurobiology

Exobiology

Chemical Evolution  
Biological Adaptation  
Life Detection Systems

Man-Machine Systems

Environmental Physiology  
Human Performance Studies  
Environmental Control  
Manned Systems Engineering Studies  
Bionics Studies

Preferred College Majors for NASA Personnel

Astronautics	Aeronautical Engineering
Astronomy	Ceramic Engineering
Ceramics	Chemical Engineering
Chemistry	Civil Engineering
Electronics	Electronic Engineering
Geology	Electrical Engineering
Geophysics	Industrial Engineering
Mathematics	Mechanical Engineering
Metallurgy	Metallurgical Engineering
Meteorology	Nuclear Engineering
Physics	Engineering Mechanics
Architecture	Engineering Physics

SOURCES OF OCCUPATIONAL INFORMATION

Aerojet-General Corp., Public Relations Dept., P.O. Box 3925, Glendale, California.

Aerospace Corp., Office of Public Information, P.O. Box 95085, Los Angeles, California 90045.

Aerospace Industries Association of America, Inc., 1725 De Sales St., N.W., Washington 20036.

Aerospace Medical Association, Washington National Airport, Washington, D.C. 20001.

American Society for Engineering Education, 1346 Connecticut Ave., N.W., Washington, D.C. 20036.

The American Society of Mechanical Engineers, Aviation and Space Division, 345 E. 47th St., New York City, New York 10017.

Douglas Aircraft Co., Inc., Radio-T.V. Services, Public Relations, Santa Monica, California.

General Electric, Public Relations Dept., 570 Lexington Ave., New York, New York 10022.

National Aeronautics and Space Administration, Educational Publications, AFEE, Washington, D.C. 20546.

. . . also see "Sources," Chapter I.

## FREE OR INEXPENSIVE MATERIALS

Unit I

NASA Facts (free)	nasa
The Man Behind The Rocket (free)	gm
Can You Talk The Language Of Space? (free)	af
Lifting Re-Entry Spacecraft (free)	mmc
Space--The New Frontier (free)	nasa
Space Travel Computer (free)	swf
Space Vehicle Design Computer (free)	mmcd
Aerospace Navigation (free)	cdc
Inertial Guidance (free)	gm
Missiles--From Concept To Countdown (free)	aia
Advanced Research (free)	nasa
NASA Installations (free)	nasa
NASA Photography (free)	nasa
A World In Space (.15¢)	gpo
Space Handbook: Astronautics and Its Application (free)	gpo
Model Rocketry (.50¢)	eii
Life Sciences For Space Use--chart (free)	gar
Aerospace Medicine (free)	afb
Pressure Suits (free)	afb
Space Medicine (free)	afb

Feeding The Astronaut In Flight (free)	afb
Aerospace Nursing (free)	afb
Bibliography--Space Medicine (free)	afb
The National Significance Of The Augmented Program Of Space Exploration (free)	nasa
The Mission of Man In Space (free)	nasa
Educational Packet--Model Rocketry (free)	eii
Ballistics Manual (.75¢)	rdg

Unit II

The Peaceful Uses Of Space (free)	iac
The Practical Value Of Space Exploration (.30¢)	gpo
Orbiting Geophysical Laboratory (free)	nasa
Satellites For Commerce and Defense (free)	aia
Complete Set Of All Unmanned Satellites (free)	nasa

Unit III

The Challenge Of Space Exploration (free)	nasa
Exploring Space (free)	nasa
Space Tools (free)	mmc
Space--Challenge and Promise (free)	aia
Beyond Apollo (free)	aiaa
A Walk In Space (free)	nasa
The Biggest Thing On Wheels (free)	uss
Footprints On The Moon (free)	ngs

0-103

Apollo/Saturn (free)	mmc
Project Apollo (\$1.00)	naec
One, Two, Three, and The Moon (free)	nasa
Speaking Of Space And Aeronautics (free)	nasa
Manned Space Flight--chart (.20¢)	ge
Astrolog (free)	trw
Celestial Mechanics (free)	cap
The Mission Of Man In Space (free)	nasa
Freedom In Space (free)	rca
AC Electronics is "Go" For Apollo (free)	ac
AVCO/RAD Builds The Apollo Ablative Heat Shield (free)	aly
Spacecraft (free)	mcd

## APPENDIX

## APPENDIX A

### ENGINEERING, TECHNICAL, AND TRADE SCHOOLS

Because of the many schools in the United States offering education in engineering, technical arts, and trades only schools in Iowa and the immediate bordering states (South Dakota, Minnesota, Wisconsin, Illinois, Missouri, Kansas, and Nebraska) are listed. However, some specialty vocations may have but a few schools offering training and these schools will be listed.

#### Aeronautical Administrator (degree)

Parks College, St. Louis University, St. Louis Missouri  
University of Minnesota, Minneapolis, Minnesota

#### Aeronautical Draftsman (non degree)

Aero University, Chicago, Illinois

#### Aerospace Engineer (degree)

Aerospace Institute, Chicago, Illinois  
Illinois Institute of Technology, Chicago, Illinois  
University of Illinois, Urbana, Illinois  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
St. Benedicts' College, Achison, Kansas  
Kansas University, Lawrence, Kansas  
Wichita State University, Wichita, Kansas  
University of Minnesota, Minneapolis, Minnesota  
Parks College, St. Louis University, St. Louis, Missouri  
Washington University, St. Louis, Missouri



Aerospace Engineering Technician (non degree)

Aero Space Institute, Chicago, Illinois  
Aero University, Chicago, Illinois  
St. Bede Jr. College, Peru, Illinois  
Grand View Jr. College, Des Moines, Iowa  
Central Iowa Community College, Ft. Dodge, Iowa  
Pratt Jr. College, Pratt, Kansas  
Wichita Drafting College, Wichita, Kansas  
Brainerd Jr. College, Brainerd, Minnesota  
Eveleth Jr. College, Eveleth, Minnesota  
St. Louis University, St. Louis, Missouri (degree)  
Fairbury Jr. College, Fairbury, Nebraska  
Wayne State College, Wayne, Nebraska

Airplane Mechanic

University of Illinois Institute of Aviation, Urbana, Ill.  
Minneapolis Technical Institute, Minneapolis, Minnesota  
Aero Mechanic School, Kansas City, Missouri  
Parks College, St. Louis University, St. Louis, Missouri  
Lincoln Aviation Institute, Lincoln, Nebraska  
Janesville Vocational School, Janesville, Wisconsin

Air Traffic Agent and Reservationist

There are many schools offering this type of training  
however, most airlines prefer to train their own  
employees for this work.

Astronautics Engineer (degree)

Polytechnic Institute of Brooklyn, Brooklyn, New York

Astronomer (degree)

Chicago University, Chicago, Illinois  
Iowa State University, Ames, Iowa  
Kansas University, Lawrence, Kansas  
University of Missouri  
University of Minnesota, Minneapolis, Minnesota  
Carlton College, Northfield, Minnesota  
University of Wisconsin, Madison, Wisconsin

Cartographer (degree)

Northwestern University, Evanston, Illinois  
Beloit College, Beloit, Wisconsin  
University of Wisconsin, Madison, Wisconsin  
Carroll College, Waukesha, Wisconsin

Ceramic Engineer (degree)

University of Illinois, Urbana, Illinois  
Iowa State University, Ames, Iowa  
University of Missouri at Rolla, Rolla, Missouri  
Washington University, St. Louis, Missouri  
Marquette University, Milwaukee, Wisconsin

Ceramic Engineer Technician (non degree)

Grand Rapids Jr. College, Grand Rapids, Michigan  
Ohio University, Athen, Ohio (degree)  
Ohio College of Applied Sciences, Cincinnati, Ohio

Chemical Engineer (degree)

Illinois Institute of Technology, Chicago, Illinois  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
St. Benedict's College, Atchison, Kansas  
Kansas University, Lawrence, Kansas  
Kansas State University, Manhattan, Kansas  
University of Minnesota, Minneapolis, Minnesota  
Missouri University, Columbia, Missouri  
Northeast Missouri State College, Kirksville, Missouri  
University of Missouri at Rolla, Rolla, Missouri  
Washington University, St. Louis, Missouri  
University of Nebraska, Lincoln, Nebraska  
South Dakota School of Mines, Rapid City, South Dakota  
University of Wisconsin, Madison, Wisconsin

Chemical Engineering Technician (non degree)

Danville Jr. College, Danville, Illinois  
Lyons Twp. Jr. College, LaGrange, Illinois  
Grandview Jr. College, Des Moines, Iowa  
Central Iowa Community College, Ft. Dodge, Iowa  
Area VI Community College, Marshalltown, Iowa  
Iowa State University Technical Institute, Ames, Iowa  
Brainerd Jr. College, Brainerd, Minnesota  
Eveleth Jr. College, Eveleth, Minnesota  
Rochester Jr. College, Rochester, Minnesota  
Evangel College, Springfield, Missouri (degree)  
McCook Jr. College, McCook, Nebraska  
Milwaukee School of Engineering, Milwaukee, Wisconsin

Chemical Technologist (non degree)

Lowell Technical Institute, Lowell, Massachusetts

Chemist (degree)

Southern Illinois University, Carbondale, Illinois  
University of Illinois, Urbana, Illinois  
Bradley University, Peoria, Illinois  
Northwestern University, Evanston, Illinois  
Knox College, Galesburg, Illinois  
Kansas State College, Emporia, Kansas  
Wichita State University, Wichita, Kansas  
University of Minnesota, Minneapolis, Minnesota  
Hamline University, St. Paul, Minnesota  
University of Missouri at Rolla, Rolla, Missouri  
University of Missouri at Kansas City, Kansas City, Mo.  
University of Nebraska, Lincoln, Nebraska  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
Drake University, Des Moines, Iowa  
South Dakota State University, Vermillion, South Dakota  
University of Wisconsin, Madison, Wisconsin  
Marquette University, Milwaukee, Wisconsin  
. . . and many others in each of the states named

Communications Agent (non degree)

Central Iowa Community College, Ft. Dodge, Iowa  
Milwaukee Vocational School, Milwaukee, Wisconsin

Communications Engineer (degree)

Southern Illinois University, Carbondale, Illinois  
University of Illinois, Urbana, Illinois  
Iowa State University, Ames, Iowa  
Washington University, St. Louis, Missouri  
University of Minnesota, Minneapolis, Minnesota  
University of Wisconsin, Madison, Wisconsin

Communications Engineering Technician (non degree)

DeVry Technical Institute, Chicago, Illinois  
Central Iowa Community College, Ft. Dodge, Iowa  
Wichita Technical Institute, Wichita, Kansas  
Electronic Institute, Kansas City, Missouri  
Fairbury Jr. College, Fairbury, Nebraska  
Wisconsin State College, Superior, Wisconsin  
Northwestern Electronics Inst., Minneapolis, Minnesota

Computer Programmer (non degree)

Central Technical Institute, Kansas City, Missouri  
Area X Vocational School, Cedar Rapids, Iowa  
Area XI Vocational School, Ankeny, Iowa  
Alverno College, Alverno, Wisconsin

Computer Technician (non degree)

Area XI Vocational School, Ankeny, Iowa  
Area XV Vocational School, Ottumwa, Iowa  
Milwaukee School of Engineering, Milwaukee, Wisconsin

Data Processor (non degree)

Southern Illinois University, Carbondale, Illinois  
Computer Schools, Chicago, Illinois  
College of Automation, Des Moines, Iowa  
Area XI Vocational School, Ankeny, Iowa  
Area XV Vocational School, Ottumwa, Iowa  
Wichita Drafting College, Wichita, Kansas  
Central Technical Institute, Kansas City, Missouri  
Nebraska Technical School, Milford, Nebraska  
Wisconsin State College, Whitewater, Wisconsin (degree)

Draftsman (Electronics)

Chicago Technical College, Chicago, Illinois  
Central Technical Institute, Kansas City, Missouri  
Milwaukee School of Engineering, Milwaukee, Wisconsin

Electrical Engineer (degree)

Illinois Institute of Technology, Chicago, Illinois  
University of Illinois, Urbana, Illinois  
Bradley University, Peoria, Illinois  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
University of Kansas, Lawrence, Kansas  
Kansas State University, Manhattan, Kansas  
Wichita State University, Wichita, Kansas  
University of Minnesota, Minneapolis, Minnesota  
University of Missouri, Columbia, Missouri  
University of Missouri at Rolla, Rolla, Missouri  
St. Louis University, St. Louis, Missouri  
Washington University, St. Louis, Missouri  
University of Nebraska, Lincoln, Nebraska  
South Dakota State College, Brookings, South Dakota  
University of Wisconsin, Madison, Wisconsin  
Marquette University, Milwaukee, Wisconsin

Electrical Engineering Technician (non degree)

Danville Jr. College, Danville, Illinois  
 Black Hawk Jr. College, Moline, Illinois  
 Iowa State University Technical Institute, Ames, Iowa  
 Central Iowa Community College, Ft. Dodge, Iowa  
 Wichita Drafting College, Wichita, Kansas  
 Dunwoody Institute, Minneapolis, Minnesota  
 Winona State College, Winona, Minnesota  
 Missouri Technical School, St. Louis, Missouri  
 Peru State College, Peru, Nebraska  
 Wayne State College, Wayne, Nebraska  
 Wisconsin State College, Superior, Wisconsin

Electronics Engineer (degree)

Industrial Engineering School, Chicago, Illinois  
 Iowa State University, Ames, Iowa  
 University of Minnesota, Minneapolis, Minnesota  
 University of Missouri at Kansas City, Kansas City, Mo.  
 South Dakota State College, Brookings, South Dakota  
 University of Wisconsin, Madison, Wisconsin

Electronics Engineering Technician (non degree)

Southern Illinois University, Carbondale, Illinois  
 DeVry Technical Institute, Chicago, Illinois  
 United Electronics Institute, West Des Moines, Iowa  
 Iowa State University Technical Institute, Ames, Iowa  
 Central Iowa Community College, Ft. Dodge, Iowa  
 North Iowa Community College, Mason City, Iowa  
 Area VI Vocational School, Marshalltown, Iowa  
 Area VII Vocational School, Waterloo, Iowa  
 Area IX Community College, Clinton, Iowa  
 Area X Vocational School, Cedar Rapids, Iowa  
 Area XI Vocational School, Ankeny, Iowa  
 Area XII Vocational School, Sioux City, Iowa  
 Area XV Vocational School, Ottumwa, Iowa  
 Area XVI Vocational School, Burlington, Iowa  
 Wichita Technical Institute, Wichita, Kansas  
 Brown Institute of Electronics, Minneapolis, Minnesota  
 Dunwoody Institute, Minneapolis, Minnesota  
 Midwest School of Electronics, Omaha, Nebraska  
 Central Technical Institute, Kansas City, Missouri

South Dakota Vocational Technical School, Springfield, S.D.  
 Milwaukee School of Engineering Technology,  
 Milwaukee, Wisconsin (degree)

Electroplater (non degree)

Illinois Institute of Technology, Chicago, Illinois  
 Purdue University Extension, Indianapolis, Indiana

Flight Training

Aerospace Technical Institute (flight, maintenance, and  
 air transport technology), affiliated with Florida  
 Institute of Technology, Melbourne, Florida  
 Ag Aviation Academy (commercial, instrument, instructor,  
 airline transport, helicopter, and agriculture pilot  
 ratings), Stead Airport, Reno, Nevada  
 American Flyers, Inc. (B.S. in Aviation, also commercial  
 multi-engine, airline transport, helicopter, and  
 instrument ratings), Ardmore Airpark, Ardmore, Oklahoma  
 Burnside-Ott Aviation Training Center (private, commer-  
 cial, airline transport, instrument, multi-engine,  
 instructor, and helicopter ratings), Opa Locka Airport,  
 Miami, Florida  
 Embry-Riddle Aeronautical Institute (B.S. in Aeronautical  
 Engineering and Airport Management, also private,  
 commercial, airline transport and instrument ratings),  
 Daytona Beach, Florida  
 Hawthorne College (B.S. in Aviation and Flying), Antrim,  
 New Hampshire  
 Northrop Institute of Technology (B.S. in Aerospace,  
 Electronics, and Mechanical Engineering, also flight  
 training and aviation mechanics), Inglewood, California  
 Spartan School of Aeronautics (all pilot ratings and  
 aviation mechanics), International Airport, Tulsa, Okla.  
 Institute of Aviation, University of Illinois (pilot and  
 mechanic ratings), Urbana, Illinois  
 Southern Illinois Air Institute, Southern Illinois  
 University (pilot ratings), Carbondale, Illinois  
 Purdue University Dept. of Aviation Technology (B.S. in  
 Professional Pilot also commercial and airline trans-  
 port flight ratings), West Lafayette, Indiana  
 Ohio State University School of Aviation (pilot and  
 mechanic ratings), Columbus, Ohio

Machinist (non degree)

Southern Illinois University, Carbondale, Illinois  
Allied School of Mechanical Trades, Chicago, Illinois  
Bradley University, Peoria, Illinois  
Dodge City Jr. College, Dodge City, Kansas  
Minneapolis Technical Institute, Minneapolis, Minnesota  
Rankin School of Mechanics, St. Louis, Missouri  
Nebraska Technical School, Milford, Nebraska  
South Dakota Vocational Technical School, Springfield, S.D.  
Milwaukee Vocational School, Milwaukee, Wisconsin

Mechanical Engineer (degree)

Bradley University, Peoria, Illinois  
University of Illinois, Urbana, Illinois  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
University of Kansas, Lawrence, Kansas  
University of Minnesota, Minneapolis, Minnesota  
University of Missouri, Columbia, Missouri  
University of Missouri at Rolla, Rolla, Missouri  
University of Nebraska, Lincoln, Nebraska  
South Dakota State College, Brookings, South Dakota  
University of Wisconsin, Madison, Wisconsin  
Marquette University, Milwaukee, Wisconsin  
. . . and many others in each of the states named.

Mechanical Engineering Technician (non degree)

Allied School of Mechanical Trades, Chicago, Illinois  
Iowa State University Technical Institute, Ames, Iowa  
Dunwoody Institute, Minneapolis, Minnesota  
Nebraska State Technical College, Wayne, Nebraska  
Milwaukee School of Engineering, Milwaukee, Wisconsin  
Area VI Vocational School, Marshalltown, Iowa  
Area VII Vocational School, Waterloo, Iowa  
Area X Vocational School, Cedar Rapids, Iowa  
. . . and many others in each of the states named.



Metallurgical Engineer (degree)

Illinois Institute of Technology, Chicago, Illinois  
 Chicago University, Chicago, Illinois  
 University of Illinois, Urbana, Illinois  
 Iowa State University, Ames, Iowa  
 University of Minnesota, Minneapolis, Minnesota  
 University of Missouri at Rolla, Rolla, Missouri  
 University of Wisconsin, Madison, Wisconsin

Metallurgical Engineering Technician (non degree)

Chicago City Jr. College, Chicago, Illinois  
 Central Iowa Community College, Ft. Dodge, Iowa  
 Highland Jr. College, Highland, Kansas  
 Milwaukee School of Engineering, Milwaukee, Wisconsin

Meteorologist and Climatologist (degree)

Chicago University, Chicago, Illinois  
 St. Louis University, St. Louis, Missouri  
 University of Missouri, Columbia, Missouri  
 Iowa State University, Ames, Iowa  
 University of Minnesota, Minneapolis, Minnesota  
 University of Wisconsin, Madison, Wisconsin

Missile Rocket Technician (non degree)

American Jet School, Inc., Michigan City, Indiana

Nuclear Engineer (degree)

University of Illinois, Urbana, Illinois  
 Iowa State University, Ames, Iowa  
 University of Minnesota, Minneapolis, Minnesota  
 University of Missouri at Rolla, Rolla, Missouri  
 Washington University, St. Louis, Missouri  
 University of Wisconsin, Madison, Wisconsin

Nuclear Physicist (degree)

University of Illinois, Urbana, Illinois  
Northwestern University, Evanston, Illinois  
Iowa State University, Ames, Iowa  
State University of Iowa, Iowa City, Iowa  
University of Minnesota, Minneapolis, Minnesota  
Washington University, St. Louis, Missouri  
South Dakota State College, Brookings, South Dakota  
University of Wisconsin, Madison, Wisconsin  
Lawrence College, Lawrence, Wisconsin

Sheet Metal Worker (non degree)

Dunwoody Institute, Minneapolis, Minnesota  
Northern State College, Aberdeen, South Dakota  
Milwaukee Vocational School, Milwaukee, Wisconsin

Steward and Stewardess (Airline--non degree)

There are many schools offering this type of training however, most airlines prefer to train their own employees for this work.

Tool and Die Designer (non degree)

Southern Illinois University, Carbondale, Illinois  
American Technical School, Chicago, Illinois  
Dunwoody Institute, Minneapolis, Minnesota  
Rankin School of Mechanics, St. Louis, Missouri  
Nebraska Technical School, Milford, Nebraska  
Milwaukee Vocational School, Milwaukee, Wisconsin

Welder (non degree)

Greer Shop Training, Chicago, Illinois  
Dunwoody Institute, Minneapolis, Minnesota  
Rankin School of Mechanics, St. Louis, Missouri  
Hobart Welding School, Troy, Ohio  
Milwaukee Vocational School, Milwaukee, Wisconsin  
Area X Vocational School, Cedar Rapids, Iowa

## APPENDIX B

### SCHOLARSHIPS AND FINANCIAL AID FOR STUDENTS ENTERING AEROSPACE SCIENCE STUDIES

#### Bausch and Lomb Science Scholarships

Description. Three or four scholarships for the study of science at the University of Rochester, Rochester, N. Y.

Information. The Director of Admissions, University of Rochester, Rochester, N. Y. 14627

#### Civil Air Patrol Scholarships

Description. Nineteen scholarships to Civil Air Patrol Cadets for the study of aeronautical engineering, teacher training, and humanities (girls) at school of their choice.

Information. CAP Undergraduate Scholarship Program, National Headquarters, Maxwell AFB, Alabama

#### Coop Work-Study and Vacation Work-Study Programs In Govt. Agencies in Washington, D.C. Area

Description. Coop work-study for a five year program when studying accounting, architecture, cartography, chemistry, economics, engineering, mathematics, meteorology, oceanography, physics, and statistics at college of student's choice.

Information. U.S. Civil Service Comm., Information and Examining Office, 800 E Street, N.W., Washington, D.C.

#### Gas Technology Option Scholarships

Description. For study of gas technology or civil, chemical, or mechanical engineering at Illinois Inst. of Technology.

Information. Personnel Director of local gas company; or Chairman, Education Program, Institute of Gas Technology, IIT Center, Chicago, Illinois 60616

General Motors Institute Engineering Program

Description. Five year coop program for men studying electrical, industrial, or mechanical engineering.

Information. Admissions Officer, General Motors Institute, 1700 West Third Ave., Flint, Michigan 48502

Hughes Undergraduate Part-Time Program

Description. Coop program for those studying engineering, physical sciences, electronics or a related discipline in a college or junior college in the vicinity of a Hughes Aircraft Co. facility.

Information. Educational Relations, Corporate Office, Hughes Aircraft Co., Culver City, California

Lockheed Leadership Fund Scholarships

Description. Fifteen scholarships for the study of business administration, finance, or a science related to the aerospace industries.

Information. Lockheed Leadership Fund, Lockheed Aircraft Corp., P.O. Box 551, Burbank, California

Mathematical Association of America Annual National High School Mathematics Test

Description. Competitive examinations which may qualify individuals for financial aid particularly for further study in the field of mathematics.

Information. W. H. Fagerstrom, Executive Director of High School Contests, M.A.A., Pan American College, Edinburg, Texas

### N S P E Engineering Scholarships

Description. Five civil engineering, one mechanical or electrical engineering, and one chemical engineering scholarships offered annually.

Information. National Society of Professional Engineers, 2029 K. Street, N.W., Washington, D.C.

### Owens-Illinois Scholarships

Description. Four year scholarships to selected colleges for the study of physical science, engineering (ceramic, industrial, mechanical), business administration, or economics.

Information. The Director of Admissions of the following colleges and mention the Owens-Illinois program:

Baylor University, Waco, Texas  
Ohio Wesleyan University, Delaware, Ohio  
Cornell University, Ithaca, New York  
Georgia Institute of Technology, Atlanta, Georgia  
Purdue University, West Lafayette, Indiana  
University of Illinois, Urbana, Illinois  
University of Wisconsin, Madison, Wisconsin  
Northwestern University, Evanston, Illinois  
Rutgers University, New Brunswick, New Jersey  
University of Toledo, Toledo, Ohio  
Ohio State University, Columbus, Ohio  
Stanford University, Stanford, California

### Pittsburgh Plate Glass Foundation Merit Scholarships

Description. Thirteen competitive scholarships based on results of the National Merit test and 17 scholarships based on the National Merit test given to residents of towns having Pittsburgh Plate Glass Co. Plants. Distribution in the sciences are 4 in chemistry or chemical engineering and 4 in ceramic, chemical, industrial, civil, electrical, or mechanical engineering.

Information. Pittsburgh Plate Glass Foundation, One Gateway Center, Pittsburgh, Pennsylvania

R.C.A. Institutes Electronics Technology Scholarships

Description. Six scholarships at the R.C.A. Electronics Institutes.

Information. R.C.A. Institutes, Inc., 350 West Fourth Street, New York, New York 10014; or R.C.A. Institutes, Inc., Pacific Electric Bldg., 610 South Main Street, Los Angeles, Calif.

R.C.A. Scholarships

Description. Thirty scholarships for science at selected colleges.

Information. Dr. Douglas H. Ewing, Chairman, R.C.A. Education Committee, Radio Corporation of America, David Sarnoff Research Center, Princeton, New Jersey

Western Union Scholarships

Description. Two scholarships for Creighton and Cornell Universities and two scholarships for any accredited college to pursue studies in science or engineering. Available to children of Western Union employees.

Information. Scholarship Program, Employee Relations Dept., Room 2111, Western Union Telegraph Co., 60 Hudson Street, New York, New York

Westinghouse (George) Scholarships

Description. Ten scholarships for science or engineering study at Carnegie Institute of Technology, Pittsburgh, Pa.

Information. Director of Admissions, Carnegie Institute of Technology, Pittsburgh, Pennsylvania 15213

## APPENDIX C

### IDENTIFICATION AND ADDRESSES OF FILM SOURCES

- af Air Force Film Library, 8900 South Broadway,  
St. Louis, Missouri
- aopa Aircraft Owners and Pilots Association, Mrs.  
Bernice Dodson, P. O. Box 9277, Southwest  
Station, Oklahoma City, Oklahoma 73119
- auto Autonetics Division, North American Aviation, Inc.,  
Public Relations Dept., 9150 East Imperial  
Highway, Downey, Calif. 90241
- cap Civil Air Patrol, National HQ, Maxwell AFB,  
Alabama 36112
- ces Cessna Aircraft Co., Box 1521, Wichita, Kan. 67201
- dac Douglas Aircraft Co., Inc., Advertising Film  
Services, Dept. G-83, Location G-20,  
Santa Monica, Calif. 90406
- faa Federal Aviation Agency, Film Library AC-142.1,  
Aeronautical Center, P.O. Box 1082, Oklahoma  
City, Oklahoma 25082
- gm General Motors Corp., Public Relations Staff,  
Film Library, General Motors Bldg., Detroit,  
Michigan 48202
- iac Iowa Aeronautics Commission, State House,  
Des Moines, Iowa
- med McDonnell Aircraft Corp., P.O. Box 516, St. Louis,  
Missouri Att: W. C. Bunch, Supervisor  
Cinematography and Exhibits
- mtps Modern Talking Picture Service, Pratt Sound Films,  
Inc., 129 Third Ave., S.W., Cedar Rapids, Ia.
- naai North American Aviation, Inc., Los Angeles Div.,  
International Airport, Los Angeles, Calif.  
90009 Att: Public Relations Dept.

nasa NASA, Lewis Research Center, Office of Educational  
Services (3-11), 21000 Brookpark Rd.,  
Cleveland, Ohio 44135

net National Educational T.V. Film Service, Indiana  
University, Bloomington, Indiana

shl Shell Oil Co., 450 N. Meridian, Indianapolis,  
Indiana 46206

sui State University of Iowa, Audio-Visual Service,  
Iowa City, Iowa

Additional film sources

American Airlines, Public Relations, 633 Third  
Ave., New York City 10017

The Boeing Co., Airplane Div. Library, Wichita,  
Kansas 67201

National Air Taxi Conference, 1346 Connecticut  
Ave., N.W., Washington, D.C. 20036

Piper Aircraft Co., Lockhaven, Pennsylvania 17745

Sikorsky Aircraft Div., United Aircraft Corp.,  
Stratford, Connecticut 06602

United Air Lines, School and College Service,  
Box 8776, Chicago, Illinois 60666

U. S. Navy, District P.I.O., 9th Naval District,  
Great Lakes, Illinois



## APPENDIX D

### IDENTIFICATION AND ADDRESSES OF SOURCES OF FREE OR INEXPENSIVE MATERIALS

- a Aeronautica, 7506 Clybourn, Sun Valley, Calif. 91352
- ac AC Electronic Division, General Motors, Milwaukee,  
Wisconsin 53201
- af USAF, Recruiting, Randolph AFB, San Antonio, Texas
- afb USAF, Aerospace Medicine, Brooks AFB, San Antonio,  
Texas
- afr Air France, % Dept., AMN.CA, 1350 Ave. of the  
Americas, New York City 10019
- agc Aerojet General Corp., 9100 E. Falir Dr., El  
Monte, Calif. 91731
- aia Aerospace Industries Association, Inc., 1725  
De Sales St., N.W., Washington, D.C. 20036
- aiaa American Institute Of Aeronautics and Astronautics,  
1290 Sixth Ave., New York City 10019
- alc Alcor Aviation, Inc., 2905 Bandera Rd., San  
Antonio, Texas 78228
- all Allison Division, General Motors Corp., Indianapolis,  
Indiana 46206
- aly Avco Lycoming Division, Avco Corp., 550 S. Main St.  
Stratford, Conn. 06497
- bac Beech Aircraft Corp., Aviation Education Dept.,  
Wichita, Kansas 67201
- cap Civil Air Patrol % Bookstore, National HQ  
Maxwell AFB, Alabama 36112
- cdc Control Data Corporation, 34th Ave. S., Minne-  
apolis, Minnesota 55420

ce Centuri Engineering Co., P.O. Box 1988, Phoenix,  
Arizona 85001

ces Cessna Aircraft Co., Air Age Education, P.O. Box  
1521, Wichita, Kansas 67201

cgl Continental General Life Insurance Co., % Public  
Relations-319, Hartford, Conn. 06115

cmc Continental Motors Corp., 205 Market St., Muskegon,  
Mich. 49443

csp Champion Spark Plug Co., 900 Upton Ave., P.O. Box  
910, Toledo, Ohio 43601

dag Dept. of Agriculture, Conservation Education Branch,  
USDA-Forest Service, Washington, D.C. 20250

dpc Dept. of Commerce, Environmental Science Services  
Administration, Coast and Geodetic Survey,  
Washington Science Center, Rockville, Md. 20852

egi Eye Gate House, Inc., 146-01 Archer Ave., Jamaica,  
New York 11435

eii Estes Industries, Inc., Box 227 Penrose, Colo. 81240

faa Federal Aviation Administration, Dept. of Trans-  
portation, HQ-438, Washington, D.C. 20590

fgi Florida Engineering and Industrial Experiment  
Station, University of Florida, Gainesville,  
Florida 32603

gar The Garrett Corp., 9851 Sepulveda Blvd., Los  
Angeles, Calif. 90009

gm General Motors Corp., General Motors Bldg.,  
Detroit, Mich. 48202

gpo Government Printing Office, Washington D.C. 20402

hs Hamilton Standard Div. of United Aircraft Corp.,  
Windsor Locks, Conn. 06096

iac Iowa Aeronautics Commission, State House  
Des Moines, Iowa

jep Jeppesen and Co., 8025 E. 40th Ave., Denver,  
Colo. 80207

lac Lockheed Aircraft Corp., 2555 N. Hollywood Way,  
Burbank, Calif. 91503

lag Lockheed-Georgia Co., 86 S. Cobb Dr., Marietta,  
Georgia 30061

lsi Lear Siegler, Inc., 3171 S. Bundy Dr., Santa  
Monica, Calif. 90406

mcd McDonnell Co., External Relations, P.O. Box 516,  
St. Louis, Missouri 63166

mmc Martin Marietta Corp., Aerospace Group, Friend-  
ship International Airport, Baltimore, Md.  
21240

mmcd Martin Marietta Corp., Denver Div., P.O. Box 179,  
Denver, Colo. 80201

naa North American Aviation Co., General Offices,  
News Bureau, Dept. 861, 1700 E. Imperial  
Highway, El Segundo, Calif. 90245

naec National Aerospace Education Council, 806-15th  
St., N.W., Room 616, Washington, D.C. 20005

nan Naval Aviation News, Dept. of the Navy,  
Washington, D.C.

nar National Association of Rocketry, 1239 Vermont  
Ave., N.W., Washington, D.C. 20005

nasa National Aeronautics and Space Administration,  
Lewis Research Center, 21000 Brookpark Rd.,  
Cleveland, Ohio 44135

nasr Naval Aviation Safety Review, Norfolk, Virginia

ngs National Geographic Society, Washington, D.C. 20036

paw Pan American World Airways, Pan Am Bldg., % Edu-  
cational Services, New York City 10017

rca Radio Corporation of America, Defense Electronic  
Products, Camden, New Jersey 08102

rdc Rocket Development Corporation, Seymour, Ind. 47274

rea REA Express, 219 East 42nd St., New York City 10017

rmc Rand McNally, Merchandise Mart, Chicago, Illinois

sae Society of Automotive Engineers, 485 Lexington  
Ave., New York City 10017

sgc Sperry Gyroscope Co., Div. of Sperry Rand Corp.,  
Great Neck, New York 11020

sol Solar, A Div. of International Harvester Co.,  
2200 Pacific Highway, San Diego, Calif. 92112

stas STAS Instructional Materials, Inc., 2100 Fifth  
St., Berkeley, Calif. 94710

swf Swift and Co., Chicago, Illinois

tex Texaco, Inc., 135 East 42nd St., New York City 10017

tha Tom Hook Associates, 3726 Oliver St., N.W.,  
Washington, D.C. 20015

trw TRW Corp., Systems Group, One Space Park, Redondo  
Beach, Calif. 90278

uac United Aircraft Corp., 400 Main St., East Hartford,  
Conn. 01608

ual United Air Lines, School and College Service,  
Box 8776, Chicago, Illinois 60666

ucsc U.S. Civil Service Commission, Chief of Office  
Services Div., R. B431, Washington, D.C. 20415

uss United States Steel Corp., Pittsburgh, Pa.

## APPENDIX E

### PUBLISHERS OF AVIATION AND SPACE PERIODICALS

- Aerospace. Aerospace Industries Association of America, Inc.,  
1725 De Sales St., N.W., Washington, D.C. 20036 (monthly)
- Aerospace Historian. The Air Force Historical Foundation,  
Bldg. 819, Bolling AFB, Washington, D.C. 20332 (quarterly)
- Aerospace Medicine. Aerospace Medical Association, Washing-  
ton National Airport, Washington, D.C. 20001
- AIAA Journal. Journal of the American Institute of Aero-  
nautics & Astronautics, 1290 Ave. of the Americas, New  
York, New York 10019 (monthly)
- Airways. Werner & Werner Corp., P.O. Box 1136, Santa Monica,  
California 90406 (monthly)
- Air Classics. Challenge Publications, Inc. 7805 Deering Ave.,  
Canoga Park, California 91304 (bi-monthly)
- Air Facts. Air Facts, Inc., 70 Nassau St., Princeton, New  
Jersey 08540 (monthly)
- Air Force/Space Digest. Air Force Association, 1750 Penn-  
sylvania Ave., N.W., Washington, D.C. 20006 (monthly)
- Air Progress. The Conde Nast Publications, Inc., 420 Lex-  
ington Ave., New York, New York 10017 (monthly)
- Air Transportation. Budd Publications, Inc., 26 Beaver St.,  
New York, New York 10004 (monthly)
- Air Travel. The Rheuben H. Donnelley Corp., 209 W. Jackson  
Blvd., Chicago, Illinois 60606
- Antique Airplane Association News. Antique Airplane Assn.,  
Rte. # 5, Municipal Airport, Ottumwa, Iowa 52501 (monthly)
- Approach. Naval Aviation Safety Review, Naval Aviation  
Safety Center, NAS, Norfolk, Virginia 23511 (monthly)
- Astronautics & Aeronautics. American Institute of Aero-  
nautics & Astronautics, 1290 Ave. of the Americas, New  
York, New York 10019 (monthly)

Aviation Week and Space Technology. McGraw-Hill, Inc.,  
330 W. 42nd St., New York, New York 10036 (weekly)

FAA News. Office of Information Services, Federal Aviation  
Agency, Dept. of Transportation, Washington, D.C. 20590

Flight. Air Review Publishing Corp., 2700 N. Haskell Ave.,  
Box 750, Dallas, Texas 75221 (monthly)

Flying. Ziff-Davis Publishing Co., One Park Ave., New  
York, New York 10016 (monthly)

Naval Aviation News. Navy Dept., Washington, D.C. 20360

Pilot. Aircraft Owners and Pilots Association, 4650 East-  
West Highway, Bethesda, Maryland 20014 (monthly)

Plane & Pilot. Werner & Werner Corp., Box 247, Pacific  
Palisades, California 90272 (monthly)

Private Pilot. Gallant Publishing Co., 116 E. Badillo St.,  
Covina, California 91722 (monthly)

Sport Flying. Challenge Publications, Inc. 7805 Deering  
Ave., Canoga Park, California 91304 (monthly)

## APPENDIX F

### MISCELLANEOUS REFERENCE SOURCES

Aerospace Bibliography--3rd Edition. National Aeronautics and Space Administration, Govt. Printing Office, Washington, D.C.

Aviation Education Bibliography--Fourth Edition. National Aerospace Education Council, 806 25th St., N.W., Washington, D.C. 20005.

Cumulative Career Index. (An annual compilation with quarterly supplements), Chronicle Guidance Publications, Inc.

A National Catalog of Scholarships and Other Financial Aids for Students Entering College. Wm. C. Brown Company Publishers, 135 South Locust Street, Dubuque, Iowa 52003.

National Directory of Schools and Vocations. State School Publications, North Springfield, Pennsylvania.

Occupational Education Programs Serving Iowa Students. Department of Public Instruction, Des Moines, Iowa 50319.

Sources of Free and Inexpensive Pictures, Pamphlets, and Packets for Aviation and Space Education. National Aerospace Education Council, 806 15th St., N.W., Washington, D.C. 20005.

World Aviation Directory. American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington, D.C. 20005. (A complete listing of all companies active in aerospace; manufacturing, service work, sub-contracting, and general and commercial aviation.)

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In October, 1957, the U.S.S.R. launched Sputnik into orbit and the world entered the Space Age. The influence of the Space Age on the United States was best shown by the changes in schools and employment.

Schools were criticized for not developing educational programs with more imagination, innovation, and holding power. Results were, in many schools in the United States, new programs, increased activity in guidance services, encouragement of innovative teaching methods, and broader curricular offerings to interest the greatest possible number of students.

A follow-up study of Dexfield Community High School graduates completed in 1963 indicated around 50 per cent of the college enrollees were attending Iowa State University and nearly three-fourths of this group were pursuing engineering studies. Of the graduates who were enrolled in technical schools over 60 per cent were pursuing electronic technology courses.

General comments taken from the 1963 follow-up study questionnaire indicated many graduates hoped more science and elective courses could be added to the Dexfield curriculum. Many graduates favored the aerospace industries for their future employer.



## I. SUMMARY

It was the purpose of this report to develop a science course of such scope and content that a curiosity of aerospace sciences would be initiated and would also inform the student of the career potentials in the aerospace industries for the Dexfield Community High School, Redfield, Iowa.

The first step in the procedures was a historical brief of aerospace education in the United States. America became a world power following World War II and the airplanes' part in building this position was a vital contribution. Educators and laymen interested in aviation and how aviation was contributing to a changing world were hopeful this information could be included in school programs. An organization to further this aim was formed in 1947--The National Aviation Education Council (NAEC). The name was changed to National Aerospace Education Council in 1962. The NAEC fosters and promotes workshops for teachers, inservice training, and publishes materials to be used in grades K through 12. Aerospace Science and Social Science courses have been added to curricular programs in many schools in the United States and flight training has become a part of school programs in California, Kansas, Georgia, and Wisconsin. The latter state's program was federally

funded under Title III of Public Law 89-10.

The second step in the procedure was a review of the literature. Selections on guidance, curriculum, and occupations in the Space Age were surveyed.

Space Age guidance reaffirms the principles of attempting to aid the individual and involvement of teachers in the guidance service.

With the world moving faster and young people being more aware of current happenings the guidance service must be receptive to new ideas, methods, and changing times. Concepts of work have changed, over emphasis on academic studies, over control of classroom situations with the possible result of creating human cybertrons,<sup>1</sup> rapid change and growth of technology, and the rapidity of which knowledge is being amassed are dimensions of guidance in the Space Age which demand that the guidance service cannot be static but, must be dynamic and move out actively to facilitate the educational process.

Space Age curriculum must shake the bonds of traditionalism and provide for the student in a contemporary or projected society. The holding power of schools was lessening and school traditionalism was felt to be the cause. It was shown that schools who adopted changes did more to

---

<sup>1</sup>NASA, op. cit., p. 42.

challenge and hold students than those who remained static.<sup>1</sup> It was also pointed out that curriculums and courses of study must be re-evaluated on a regular short-time basis and changes accomplished when needed, not in wholesale lots presupposing a time lag<sup>2</sup> would be in the school's favor.

The Civil Air Patrol related seven modern curriculum trends to Space Age education as a rationale for Aerospace Education<sup>3</sup> as Aerospace Education had been shown to challenge students and increase the school's holding power.<sup>4</sup>

Occupations in the Space Age began to skew more to skilled craftsmen, trained technicians, and those occupations requiring greater degrees of education. The aerospace industries' growth was active and would continue to be active into the mid 1970's. Although government spending cut-backs slowed activity in the space program civilian consumer products developed from space program research were expected to keep the industry healthy and growing.

Four of the aerospace industries, Electronic, Data Processing, Air Transport, and General Aviation employ more

---

<sup>1</sup>Samuel J. Saden, "New horizons For Space Age Youth," School Science and Mathematics (June, 1965), 493.

<sup>2</sup>NASA, op. cit., p. 24.

<sup>3</sup>CAP, loc. cit.

<sup>4</sup>Samuel J. Saden, "Curricularizing Space Age Education," Education (Feb., 1965), 35.

than one-half of all aerospace industry personnel and were expected to show steady growth patterns into the 1970's.

The aerospace industries represented great growth potentials, opportunities for skilled and technically inclined people, and motivation for a person to continue his education so as to be able to become a part of this American industry.

The final step of the procedure was to develop an outlined course of study and to include "Teacher Aids and Enrichment" after each teaching unit outline. It was the purpose of the latter inclusion to provide the teacher with: subject-matter information sources from books and periodicals; film suggestions and sources; free or inexpensive supplemental materials; suggested activities and projects; and occupations in the subject matter area and sources of occupational information. The appendix of the outline contained selected schools for aerospace science and technology studies and other information pertinent to the outline.

The outline correlates with FUNDAMENTALS OF AVIATION AND SPACE TECHNOLOGY, Institute of Aviation, University of Illinois, Urbana, Illinois.

## II. CONCLUSIONS

Aerospace Science was offered as an elective science course for juniors and seniors during the school years 1965-1966 and 1966-1967. Seventeen seniors (15 males and 2 females) enrolled and completed the course during the 1965-1966 school year. During 1966-1967 school year 18 students (12 seniors and 6 juniors--all males) enrolled and completed the course.

At the end of each school year each member of the Aerospace Science class was asked to complete a statement of their opinions of the course: Did the course fill the need they had for taking the course, and did the course aid or influence their post high school plans? (Of the first group completing the course, only seven had planned to continue their education beyond high school. Four had planned on college and three--all boys--had planned on attending cosmotology school.)

Briefly, the results from the first student evaluation including their activity one year later were:

1. Fifteen felt the course informative and served the purpose.
2. Two felt otherwise.
3. Four were enrolled in four-year colleges--no change from previous plans.

4. One enrolled in nurses' training and has been accepted for stewardess training following graduation--represents change in plans.
5. One enrolled in a junior college and has completed flight training, object commercial aviation--had planned on cosmotology.
6. Four were enrolled in electronic training--two had planned on cosmotology and two no previous plans.
7. One enrolled and completed an electronic drafting technology course--no previous plans.
8. One enrolled and completed a welding trade course and is employed by an aircraft manufacturer--no previous plans.
9. Three enlisted in military service, one is an aircraft mechanic (USN), one is an aviation machinist (USAF), and one is in the Marines--the first two enlisted after the results of their aptitude tests indicated the type of schooling they were qualified for and subsequently received--all three no previous plans.
10. Two were employed--no plans, no change.

The post high school plans of ten of the class of 1965-1966 were influenced by information they had received in the Aerospace Science class.

The second class, 1966-1967, was different from the first group as there were only 12 seniors and 11 of the 12 seniors had planned to continue their education in college prior to the start of the 1966-1967 school year. At the conclusion of the course all felt the course worthwhile and the 12th senior had enrolled in a two-year data processing course. Four of the 11 seniors entering college were planning to join the Air Force R.O.T.C. unit on the campus they will attend and two others, previously undecided on college course of study, had decided on engineering areas used in the aerospace industries. Three of the six juniors were planning on attending college prior to taking the Aerospace Science course. After completing the course one of the three remaining juniors had decided to attend college and two were planning on electronics school. One senior and one junior began flight training at the conclusion of the school year.

All in all, 20 of the 35 students felt their post high school plans had been influenced by the Aerospace Science class and 33 of 35 felt the class was worthwhile and doing what the course purported to do--initiate an interest in the aerospace sciences and inform the student of career potentials in the aerospace industries.

### III. RECOMMENDATIONS

Based on the limited experience of two successful years of Aerospace Science at the Dexfield Community High School and the enthusiastic reception of the course by the students it was recommended the course be continued with year-to-year up-dating until such time the course no longer serves the best interests of the students and the school.



BIBLIOGRAPHY

## A. BOOKS

Ashby, W. Ross. Design For A Brain. New York: John Wiley & Son, Inc., 1960.

Kelley, Janet A. Guidance and Curriculum. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1955.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES,  
AND OTHER ORGANIZATIONS

Aerospace Industries Association, Inc. 1966 Aerospace Facts and Figures. Washington, D.C.: AIA, Inc., 1966.

Air Transportation Association of America. Air Transportation Facts and Figures. Washington, D.C.: ATAA, January, 1967.

Bureau of Labor Statistics United States Dept. of Labor. Occupational Outlook Handbook. Washington, D.C.: Govt. Printing Office, 1966-67.

Civil Air Patrol. Aerospace Education. Maxwell AFB, Alabama: National Headquarters, CAP, 1966.

Glass, Fred M., Chairman. "Summary of National Aviation Goals: A Study ordered by President John F. Kennedy defining aviation goals that applied to the period 1960 through 1970. Washington, D.C.: Govt. Printing Office, September, 1961.

Harbeck, Richard and Bettina Weary. "Selected Aerospace Career and Scholarship Information," Selected Science Services. Washington, D.C.: U.S. Dept. of Health, Education, and Welfare, Govt. Printing Office, 1962.

Johnson, R. J. and J. M. Hancock, editors. Aerospace Education. Washington, D.C.: National Aerospace Education Council, 1965.

Martin Co., Public Relations Dept. Contributions to Science and Technology. Friendship International Airport, Maryland: Martin Co., 1965.

Mehrens, H. E. Education-Aviation and the Space Age.  
Maxwell AFB, Alabama: National Headquarters Civil  
Air Patrol, 1963.

National Aeronautics and Space Administration. A Guide to  
Careers in Aero-Space Technology. Washington, D.C.:  
NASA, Govt. Printing Office, 1965.

\_\_\_\_\_. Educational Guidance in the Space Age. In co-  
operation with the U. S. Dept of Health, Education, and  
Welfare. Washington, D.C.: Govt. Printing Office, 1964.

Thomason, Leslie L. A Summary of the Curtis Commission  
Report Forecasts. Wichita, Kansas: Cessna Aircraft  
Co., 1955.

United States Congress, Senate Committee on Govt. Operations,  
Statement made by Ide K. Boltz, President, National  
Aerospace Education Council, hearing before Committee,  
90th Congress, 1st. Session on S. 1602, October 27,  
1967. Washington, D.C.: Govt. Printing Office, October,  
27, 1967.

Utility Airplane Council of the Aerospace Industries Asso-  
ciation, Inc. General Aviation--Today and Tomorrow.  
Washington, D.C.: AIA, Inc., 1965.

### C. PERIODICALS

Carey, Max and Lloyd David. "Down to Earth Facts About  
Aerospace," Occupational Outlook Quarterly, X (May,  
1966), 5-11.

Ferguson, C. Guy and Robert S. Tiemann. "The Man Behind  
the Man in the Moon," Occupational Outlook Quarterly,  
X (May, 1966), 1-4.

Fulton, Joseph F. "New Job Horizons in Defense-Related  
Work," Occupational Outlook Quarterly, VII (December,  
1963), 1-3.

Gardner, Paul. "NASA Counsels the Earthbound," Occupational Outlook Quarterly, X (May, 1966), 12-17.

Greenspan, Harry. "Electronic Computer Industry: A Young  
Giant," Occupational Outlook Quarterly, XI (December,  
1967), 18-19.

McAllister, Gerald J. "Aerospace Notes and Aerospace Employment," Aerospace (April, 1967), 12-14.

Ross, Arthur M. "Counseling and the World of Work in the 1970's," Occupational Outlook Quarterly, X (May, 1966), 19-23.

Saden, Samuel J. "Curricularizing Space Age Education," Education (February, 1965), 35.

\_\_\_\_\_. "New Horizons for Space Age Youth," School Science and Mathematics (June, 1965), 493.

Thomason, Leslie L. "A High School Aviation Program That Works," Flight (Reprint of article appearing in Flight magazine and distributed through the Cessna Aircraft Co., Wichita, Kansas.) (December, 1965).

#### D. UNPUBLISHED MATERIALS

Beech Aircraft Corp. Job Titles (Furnished by the Personnel Dept., Beech Aircraft Corp., Wichita, Kansas.).

Collins Radio Co. Job Titles (Furnished by the Personnel Dept., Collins Radio Co., Cedar Rapids, Iowa.).

duPont, The Alexis I. Special School District. Program For The Air Age. Wilmington, Delaware.

Mc Donald Aircraft Corp. Job Titles (Furnished by the Personnel Dept., McDonald Aircraft Corp., St. Louis, Missouri.).

Pluimer, Harold. "Frontiers of Education in the Space Age," Talk presented to the Dallas County Teachers' Institute, Adel, Iowa, September 25, 1967.

United States Dept. of Transportation, Federal Aviation Agency. Job Titles (Furnished by the Personnel Div., F.A.A., Washington, D.C.).